The Gold Fields of Nova Scotia

A Prospectors Handbook

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Halifax, Nova Scotia

A concise survey of the important mining and geological features of Nova Scotia in respect to its gold mining possibilities.

With Colored Index Map and numerous Illustrations.

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INTRODUCTION.

MR PREST has devoted the past forty years of his life to an intimate and practical study of the gold fields of Nova Scotia and has embodied in the memoir herewith the net results of his observation, couched in such language as will appeal to the average prospector who devotes his attention to the worthy and often unrewarded labor of discovering and bringing into existence, profitable ore deposits. Nova Scotia the most eastern province of Canada has long been known as the location of a large and valuable area of auriferous bearing rocks and the work done in the past which has resulted in an officially recorded production of gold equal to over seventeen million dollars is the best evidence of the future which awaits safe conservative development in opening up the innumerable unworked deposits which dot the province. In mining, success turns very often upon apparent trifles, and observation to be of value must be minute, painstaking and long continued. In addition there must be brought to the task, that love for the work, without which no craftsman can hope for individual thoroughness. That Mr. Prest has approached his subject with a full appreciation of the necessity and desirability of placing before serious investigators such facts as he has learned during a life time of effort will be apparent to the reader, and it is the latter who must recognize the importance of giving heed to the details of ore occurrences in Nova Scotia and the general laws which they follow, if he is to take advantage, fully of the recommendations offered.

That Nova Scotia offers a splendid field for developments in connection with her gold deposits, is to repeat a truism, yet there are those who after cursory glimpsing of the ground floor are bold enough to dogmatize to the contrary and the strangest part of such a condition is that their ill considered opinions and wrongly reached conclusions at times have a weight attached to them neither justified by the writer's knowledge of his subject, his opportunities for study, or his ability to assimilate the outstanding features which make this province unique in respect to its mineral deposits.

Indifference, dishonesty, incompetency and the many other human frailties which hamper mankind we shall doubtless always have with us, but that their effects should be so directed as to interfere with the legitimate opening up of all sources of material wealth, is to be

deplored but intrinsic worth we feel will nevertheless rise superior to even these handicaps and we look forward to the day when what has been done in many other countries will be repeated in Nova Scotia. That is, that confidence, capital, skill and resolution will jointly embark under proper conditions, in the development of Nova Scotia gold deposits and will reap the undoubted reward which awaits the opening up of this as yet undiscovered country.

The editor has but one further suggestion to offer to prospective investigators, and that is to rely upon local knowledge more largely than upon geological theory and let all operations be carried on with a single view to efficiency and thoroughness.

We place particular emphasis on the great value of local knowledge added to a general metallurgical and engineering training, because it spells success. Many failures in Nova Scotia can be plainly traced to a superficialty and wilful disregard of knowledge of the structural peculiarities of the district worked in, coupled with the tendency to erect large and expensive plants in advance of underground work and surface exploration which alone should be the basis of expansion in facilities for treatment of ore.

The map which is supplied with this book is intended to guide our reader to the sources from which fuller detailed information may be obtained as embodied in the valuable labors of the Canadian Geological Survey and published from time to time in the form of maps, plans, sections and geological sheets and which represents largely the work of Mr. E. R Faribault who has devoted also the best part of his useful life to the same subject and who holds a place second to none in the hearts of all who are interested in the honest development of Nova Scotia gold fields and whose best monument is the counsel and assistance which is to be had from his official publications which are still further referred to throughout this work.

In conclusion let us emphasize the importance of preliminary study in taking up the matter of development of our gold districts so that the chance of error may be reduced to its least possible magnitude.

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Editor of Industrial Advocate.

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Preface.

During my long drawn out struggle to gain a knowledge of the subject here presented I have often felt the need of an instructor or a guide book to aid me. Many of my early futile attempts to find a rich lead would probably have ended in success had I then the knowledge necessary to unravel the problems continually coming forward to baffle me; and even now, 50 years after the discovery of gold in Nova Scotia, there is not in print here any systematic information that would aid the prospector in his work. I shall therefore try to fill the void with this contribution; setting forth chiefly the results of my own experience, and adding such information from other sources as may be suitable for the needs of the prospector in Nova Scotia particularly.

There are numbers of men who have little or no knowledge of Geology in any of its phases, who must however get a grasp of the main principles, and finally the special details of the subject in order to win any measure of success in the work in hand.

There are problems in this pursuit calling for the closest observation, the most shrewd reasoning, and the best summarizing of results, before success can be attained. To train a man of ordinary capacity to the point where he will be able to direct operations in prospecting in this region of deep surface is a long and laborious task, therefore every simplification of language, every short cut in teaching and every substitute in working, must be taken advantage of, intricate geological questions must be thoroughly understood by men unacquainted with technical terms, and so the simplest wording and the most familiar examples must be made use of. It is impossible to separate the actual work of prospecting from the geological problems with which they are so closely connected. But this difficulty will be got over by the avoidance of technical terms and the use of plans wherever possible. It is only in this way that the prospector can quickly and easily grasp the most practical parts of the problems presented.

In order to attain success the prospector should have a mastery of local detail, and to this end many minute particulars uninteresting to the general reader especially in regard to faults, a very important part of the subject, are entered as a necessity. This lack of local knowledge is what apparently has caused the failure in Nova Scotia of many widely known mining engineers.

Many technical terms have here been replaced by words in common use, which, if not giving the facts with scientific exactness, at least impress the ordinary man with the true meaning better than any word that he would need to hunt up in a dictionary; if indeed he could find it there.

CHAPTER I.

Location and Production.

The discovery of gold in Nova Scotia is an old old story, as early documents and geographical names indicate. We have the old names, Cap D'or and Bras D'or, of the early French discoverers. In 1759 the journal of the Rev. John Seacombe of Lunenburg contains references to Gold River. About 1850 Thomas Hurley, a tailor of Musquodoboit, showed many fine specimens of gold to the country people there. His story, well known to many, conveys the idea that his find was located 3 or 4 miles west of Mooseland. The next recorded find was made by Captain Lestrange, while moose hunting in 1858 at the place where the Mooseland Gold Mine was afterwards opened. In 1860 John Pulsifer, acting on information given by the Indians, found gold near the outcrop of the old Furnace Lead Mooseland This was the first officially recognized discovery.

When the discovery was published abroad it brought the usual rush of excited prospectors with their visions of untold wealth. Many and amusing are the stories told of their ignorance and cupidity. But the gold was not found in the great quantities they expected, and with food and patience exhausted the crowd melted away, only the more persevering and better provided remaining for any length of time.

Then about 1862 capital was introduced and mills built in a number of districts. From that time on mining has been carried on, with many ups and downs it is true, but still continuous to the present day. The mines were small but often very profitable. Several attempts have been made to mine and mill low grade ore on a large scale. The last of these low grade ventures, the Boston Richardson, after several years of moderately profitable work, closed down in 1911. Some mines of fairly good ore, such as the Dufferin, started and operated by Western mining engineers, were failures from the start, while tributors working on a small scale were making money. Prospectors have been condemned during the last few years for searching for small rich leads instead of paying more attention to large bodies of low grade ore.

Now those who comment in this style know that it takes many thousands of dollars to develop a large ore body and put up a milling and mining plant to handle it Such an amount as this is unobtainable in Nova Scotia for gold mining, and owing to the unreasonable prejudice abroad, impossible to obtain there. If the prospector had a vein of three ounce ore and a well defined paystreak he would find it hard enough to raise

the money for a 5 stamp mill in this Province. Therefore he is pursuing the only path left him—hard work, strict economy, and a struggle to the limit for something easy to develop and cheap to work.

I would suggest that those who condemn him help him to finance some of those big enterprises that are so easy to talk about but so hard to put through.

Most of the gold produced from Nova Scotia has come from small mines and mills. The narrow rich paystreaks, easy to raise money for and cheap to work, have been the salvation of gold mining in Nova Scotia. This is the country of the small capitalist; but undoubtedly the profit on the capital invested has been as high as in any gold mining country in the world.

The progress of gold mining in Nova Scotia is shown fairly well in the following tables, which are made up of extracts from official reports. The returns of every fourth year are entered here because they show the ups and downs of the business better than any other selection could. They include the yield of gold from the West Gore antimony mines, which were not at first included in the general returns.

Year.	*Quartz crushed.*		*Ounces of gold.*	
1862	6473	tons	7275	ounces
1866	32162	"	25204	"
1870	30829	"	19866	"
1874	13844	"	9140	"
1878	17790	"	12577	"
1882	12081	"	14107	"
1886	29010	"	23362	"
1890	42740	"	24358	"
1894	39333	"	14980	"
1898	86331	"	31104	"
1902	192076	"	28270	"
1906	65278	"	14367	"
1910	49558	"	10625	"

The present condition is shown by the returns for the years 1911 and 1912.

1911	18319	tons	8188	ounces
1912	15862	"	4949	"

At present the Nova Scotia gold mines are in a very quiet condition, though many rich leads still lie hidden beneath the surface. The present state of affairs, leading to low prices and good terms, offers the best chance ever known here for investment; and it is only a want of confidence in our own resources, coupled with a want of enterprise, that prevents an upward turn in gold mining.

The following table shows the production of gold from each gold district from 1862 to 1912 inclusive with value. That got in the course of development or of prospecting is entered as "Other districts."

District	Tons Crushed	Total yield of Gold oz.	Value at $19.00 an oz.
Caribou and Moose River..	220027	60196	1,143,727
Montagu.........	29523	42173	801,190
Oldham	58735	67343	1,279,520
Renfrew...	61319	48508	921,660
Sherbrooke	300213	[illegible]	2,908,711
Stormont	525237	[illegible]	2,280,448
Tangier......	64112	28230	536,385
Uniacke	63351	43983	835,679
Waverley........	155520	69980	1,326,630
Brookfield	93527	38709	735,473
Salmon River	118819	41852	795,193
Whiteburn	6907	9800	186,200
Lake Catcha	29637	27468	521,902
Rawdon	12189	9606	182,518
Wine Harbor	77396	34992	664,863
Fifteen Mile Stream.........	36878	17363	328,897
Malaga Barrens....	22926	20305	385,807
West Gore (from Stibnite Ore).........	3240	4512	85,743
Other Districts.....	143558	74959	1,424,229
Total..	2,023,114	913,625	$17,358,876

The gold mines of Nova Scotia are more easily reached from the great centres of commerce than any in the world. No mine is more than 15 miles from a seaport or railroad, and government roads reach nearly all of them. As a rule the gold mining districts are well defined naturally and surveyed. Within their limits nearly all the prospecting in Nova Scotia has been done. The 95 or 100 localities in which gold has been found or mining has been done are nearly all included in the five counties of Guysboro, Halifax, Hants, Lunenburg and Queens. Some of these are undeveloped, being noted only for the rich quartz boulders found on the surface. These indicate the presence below of gold bearing leads, the finding of which will be the work of the prospector of the future.

Below is a list of these gold bearing localities.

Guysboro County.

Queensport
Country Harbor
Head of Isaac's Harbor
Wine Harbor
S. W. Brook Country, Hr. Cross Roads
Cochran Hill
Stillwater
3 Miles North of Goldenville
Liscomb
Liscomb Lake
Millers Lake
Forest Hill
East Isaac's Harbor
Indian Harbor Lake
Gegogan
Crow's Nest
Goldenville
Upper Seal Harbor Lake
Liscomb Mills
West Branch Liscomb River
Stewart Brook

Halifax County.

Harrigan Cove	Moosehead
Salmon River	Lochaber
Ragged Falls	Sheet Harbor
Fifteen Mile Stream	Indian Lake
Ecum Secum	Upper Moser's River
Como Lake on 7 Mile Stream	Round Lake on 17 Mile Stream
Dayspring Lake on 17 Mile Stream	
Killag	Beaver Dam
Caribou	Moose River
Gold Lake	Mooseland
North Mooseland	Glenmore
Lindsay Lake	Tangier
Clam Harbor	Chezzettcook, (East)
Lawrencetown	Cow Bay
Montague	Waverley
Oldham	Hornes Settlement
South Uniacke	Rocky Brk. Shubenacadie Lk.
Head of Chezzettcook	South of Goffs Guysboro Road
Shiers Point	

Hants County.

Mt. Uniacke	Renfrew
Little Nine Mile River	Three Mile Plains, (Fall Brook)
Central Rawdon	East Rawdon
Upper Rawdon	West Gore
McKays Settlement	Ardoise

Colchester County

Gays River	South Branch
Wright's (East of S. Branch)	Brookfield
Pembroke	

Victoria County.

Middle River	Barachois

Lunenburg County.

Gold River	Tancook
Mill Road, New Ross	Blockhouse
Centre	Indian Path
Upper Cornwall	Moores Road
Spondo	Ovens
Pleasant River Barrens	Somerset
Reinhardt's Mill	Vogler's Cove

Inverness County.

Cheticamp	River Denny's
Whycocomagh	Forest Glen Margaree

Queens County.

West Caledonia	Kejik-ma-Kujik (West side)
Whiteburn	Brookfield
Malaga	Fifteen Mile Brook
Mill Village	Port Mouton
Broad River	

Yarmouth County.

Carleton Kempt Tusket Pubnico Chegogin

Digby County.

Meteghan

King's County.

South Mtn. Berwick

The gold bearing rocks of Cape Breton Island are as yet only slightly prospected, and very few gold returns have ever been made. They therefore, hardly justify any extended description at the present time, but there is not wanting evidences of important deposits in association with other metals.

The gold bearing rocks of Nova Scotia occupy a tract of county extending from Canso to Yarmouth, a distance of about 260 miles

There are also in Cape Breton a few patches of gold bearing rocks, though belonging to a different rock formation. In Nova Scotia proper they vary greatly in width. In the eastern counties the width is from 10 to 38 miles. In the western counties the extreme width is about 60 miles, measuring from Digby town to Port Mouton on the southern coast. The total area of these and the associated rocks is about 11,000 square miles, not including the gold bearing rocks of Cape Breton, which are uncertain in their distribution.

These rocks include much beside the true gold bearing series. There are ;

1st. Quartzites (whin) and slates which appear to have been the original or foundation rock of the whole tract.

2nd. Gneisses and schists, chiefly in the western, counties, are the partly molten or baked quartzites and slates mentioned above.

3rd. Granites—completely molten quartzites and slates, often erupted when in this state into cracks in the surrounding rocks, cooling quietly in some places, but the cause of much disturbance in others, as at Country Harbor and Forest Hill.

The gneisses and schists of Shelburne and Yarmouth counties, though entered on the maps as a part of the gold bearing series, have not so far been proved to contain gold bearing leads of value. A few sights of gold have been reported from Shelburne county but the reports have not been verified. A few sights have also been reported from the gneisses of New Ross.

Of the 11,000 square miles given above, the quartzites and slates and their baked representatives the gneisses and schists, occupy about 6,500 square miles, as follows:—

Guysboro County		Square Miles	760
Halifax	"	"	1475
Hants	"	"	230
Colchester	"	"	55
Lunenburg	"	"	696
Queens	"	"	1004
Shelburne	"	"	768
Yarmouth	"	"	670
Digby	"	"	660
Annapolis	"	"	130
Kings	"	"	85
Total square miles			6533

The measurements for these estimates for the eastern counties are taken from Mr. Faribault's maps while those for the western counties with the exception of Kings County are from my own surveys.

In this area are included the gneisses and schists of Shelburne and Yarmouth counties, measuring probably between 600 and 700 square miles.

The coming survey of Queens and other western counties by Mr. Faribault will add much valuable information not now available.

CHAPTER II.

Outline of the Mines Act.

The mining lands of Nova Scotia are vested in the King and administered by the local provincial government and the evils of private ownership as known in other countries are to some extent prevented. The lands are leased at a nominal yearly rental, which however is not large enough to prevent speculators from holding large tracts for big prices. They thus keep out live investors as well as the man of limited means but long experience and whose knowledge of gold mining in Nova Scotia is almost the only ray of hope left the industry. To kill this dog in the manger policy the rental should be advanced to at least $1.00 per area. Still matters are not so bad as when the rental was 25c per area, when an army of speculators held up nearly all those who showed any disposition to go into actual mining. We are looking forward to this much needed improvement.

That part of the Mines Act referring specially to the precious metals begins at Section 160. The sections before that are of general application. The merest outlines will be given here, and the reader will be referred for further details to the Act itself.

Section 32. Mining without a license or lease punishable by a fine of $10.00 to $50.00 per day.

42. All rents are to be paid on or before July 2nd in each year. If said rents remain unpaid for 30 days thereafter the areas shall be forfeited.

45. 2 per. cent. royalty shall be paid on the value of all gold, silver, or tungsten on or before the 10th of January, April, July or October.

52. Any lease may be forfeited for failure to pay the royalty.

63. Every holder of a license may enter upon private lands.

65. If the owner of land worked on does not within three months after the expiry of such license claim damages, he shall lose the right to recover damages.

68. No lessee shall enter upon private lands until he makes an agreement with the owner.

69 to 79 deals with the course to be taken by lessees to get land from unwilling owners. If no agreement can be arrived at, arbitrators will decide upon the value of the land needed.

117. There shall be kept in the Mines Office maps and plans of all mining districts in Nova Scotia which shall be open to the inspection of the public.

118 to 136. There shall be kept in the Mines Office books of reg stry, in which shall be recorded all licenses, leases, transfers, judgements, writs of attachment and other legal documents. The fee for examining books of registry is 25c.

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162. All gold mining lands shall be laid off in areas of 150 ft. E. and W. by 250 ft. N. and S. all courses being magnetic.

164. Surface lines shall be horizontal while boundaries are vertical.

165. A licensed block of areas shall not be over twice as long as it is wide.

167. Every application for a license or a lease shall specify the areas and shall be for not less than 6 areas. Each licensed area shall cost 50c and each leased area shall cost $2.00.

169. No license except an alluvial license shall include more than 100 areas.

170. A discoverer of gold or silver shall have one week after staking his discovery, and 24 hours additional, for each 15 miles from the Mines Office to make application.

171. Before a license is issued the licensee shall make an agreement and enter into a bond to pay the owner of the land for all damages, to pay royalty, and make returns at the expiry of the license.

172. A prospecting license shall last 12 months.

173. Within this period the licensee shall select areas to be leased.

186. Surveys are to be made in the presence of all parties interested.

191. Any licensee or lessee in a district where 100 adjoining areas have been taken up may make application for the establishment of a base line. The base line shall be surveyed within three months after such application.

193. Every one who alters or removes a surveyor's mark shall be liable to a penalty of from $100 to $500 for each offence.

194. No one shall mine within ten feet of the boundary line of his territory without the consent of the lessee of the adjoining areas. If so he shall be liable to a penalty of $50.00 or imprisonment for three months.

195. Every lessee shall on or before the second day of July each year, pay in advance a rental of 50c per area.

196. Forty days work shall be done on each area each year. (Payment of rent as in Section 195 makes this section null and void.)

197. Performance of work specified in 196 entitles the lessee to a refund of the rent called for in Sec. 195.

198. Every lessee before the 10th days of January, April, July, and October of each year shall make returns to the Commissioner with the following particulars :—

a. The number of days work done on such areas during the preceding quarter

b. The number of tons of quartz raised during the preceding year.

c. The person to whom the same has been sold with the date of sale.

d. the weight of all quartz sent during the quarter to any licensed mill and when it was sent.

e. the yield of gold from each lot returned by the mill licensee.

f. The total yield of gold obtained from the mine in any manner during the quarter.

Such return shall be verified by an affidavit.

During the year 1912 an Act was passed specifying that all properties remaining unworked for 5 years shall be liable to forfeiture providing that some applicant is prepared to work the said property and pay to the former owner a price agreed on or decided by arbitration.

One of the rules of the office is that all leases must be dated on July 2nd. If a prospecting license expires on January 2nd, the time between then and the issuing of the lease is put to the credit of the lessee. If the license expires between July 2nd and December 31st the license becomes that much shorter.

CHAPTER III.

Structure of the Gold Fields.

The rocks of our gold fields consist of granite, gneiss, schist, quartzite, (whin) and slate. The whin and slates are the true gold bearing rocks in Nova Scotia, though in Cape Breton the only gold found is from schists and other metamorphic rocks. The Cape Breton gold bearing rocks are supposed to belong to an earlier age than those in Nova Scotia and are much changed from their original condition. Owing to their small importance as gold producers they have not been studied nor developed to the same extent as in Nova Scotia.

The lower part of the true gold series, consisting of quartzite (whin) is about 26,000 ft. thick, while the upper part composed of slate is about 13,000 ft. thick. Through nearly its entire thickness the whin has shown paying leads, while only near its junction with the whin has the slate shown any values worthy of note.

The granite, gneiss, and schist, of a later age than the whin and slate, are chiefly if not wholly the results of the melting or baking of the whin and slate.

The granite interrupts the whin and slate irregularly and frequently in the Eastern Counties, and cuts them off completely west of Halifax. In Lunenburg County the granite and gneiss is extensively developed, continuing in a broad inland belt to Shelburne and Yarmouth Counties. There it gradually changes into gneiss and schist. The gneiss there becomes highly charged with hornblende and garnets, while the schists, especially near Pubnico, become contorted and filled with talc and mica as well as garnets of large size. Though gold has been reported from these rocks the report has not been verified.

At first lying flat, the gold series is now bent into huge folds from 1 to 10 miles across, running as a rule east and west and dipping at every angle from vertical to slightly inclined layers.

These folds are called anticlines while the hollows between them are called synclines. The anticlines of the eastern counties are usually long, narrow and parallel with each other and seldom divided by cross synclines. Their dips are usually steep, sometimes being overturned so that the south side of a fold instead of dipping south as formerly now dips north. A beginner is very apt to be deceived, therefore the surrounding rocks should be very closely examined especially on the Gold Lake, Killag, and a few other anticlines that are known to have been overturned.

The anticlines of Lunenburg and Queens Counties are rounder, flatter, more irregularly disposed, and divided by wider and deeper cross synclines than farther east. There are few if any overturned dips and therefore less confusion and trouble on that score for the prospector. The continuity of the anticlines is less interrupted by granite, but then owing to the presence of deep cross synclines the different folds or domes are not so distinctly connected in ranges as they are in the Eastern Counties.

At the western extremity of the province the anticlines and synclines are more evenly disposed, tolerably free from faults and twists, and in Digby County the disturbances that result in quartz veins and other ore bodies are absent. The Sissiboo and Meteghan folds resembles somewhat the long and continuous folds common to Guysboro and Halifax counties. Gold has been reported from Meteghan and quartz is present, but lacking the minerals usually found with gold farther east.

In the Eastern Counties some of the main folds reach for nearly 100 miles. Others run side by side from 10 to 60 miles in length and then unite, as do the the Goldenville and Stillwater anticlines at Moose River Two more unite at Lawrencetown, and the Big Liscomb and Upper Musquodoboit anticlines unite at the latter place. Other large folds carry on their sides smaller folds which are the seat of highly productive golds mines, such as Isaac's Harbour, South Uniacke and Harrigan Cove while the main fold is barren. Others such as Wine Harbor and Three Fathom Harbor gradually flatten and give place to a syncline. Single local folds or domes such as Oldham in Halifax County and Northwest in Lunenburg County are also seen. These latter are exceptions in the Eastern Counties and as a rule the prospector will be able to trace important folds through several districts. Some, such as the Mt. Uniacke anticline, though continuous, can be traced through short overlapping folds to the north east and south west. (See map issued by the Dominion Geological Survey.) The intervals between the folds are not of the same width, neither is there any regularity in the distribution of the gold districts. Geology does not furnish any general rule for the finding of gold mines, therefore a thorough local knowledge will be your chief aid in the search. A knowledge of the location of these folds and the gold bearing elevations of the lower beds that we call domes, are a very necessary part of the prospectors stock in trade.

The Western County folds are cut across by such wide and deep synclines that it is difficult in some cases to trace them. Some, such as the Molega fold are almost completely cut off from the neighboring folds

east and west by many miles of slate. The largest number of folds, counting them from south to north, are found in that section reaching from the coast east of Halifax to the West Gore Antimony mines in Hants County. They are as follows :—

1. Three Fathom Harbor anticline. Flattens out 10 miles east in a syncline.
2. Lake Catcha—Salmon River. Ends at Bear Cove mouth of Halifax Harbor.
3. Eastern Passage (Local). West of Cole Harbor.
4. Lawrencetown. Formed by union of two folds from the east. Crosses Halifax.
5. Montague. Runs from Dartmouth Canal to Porters Lake.
6. Birch Cove (Local). Crosses Bedford Basin.
7. Waverley. Ends in the granite, east and west. 12 miles long.
8. Long Lake (In slate). Reaches far east of Oldham.
9. Oldham (Local). 8 miles long.
10. Lornes Settlement. Reaches west to Pockwock Lake.
11. South Uniacke gold district is a small side fold on Hornes Settlement fold.
12. Oland (In slate). Reaches west to the granite. Runs under the Coal formation.
13. Mt. Uniacke — Renfrew. Runs east under Coal Formation.
14. Upper Rawdon. Overlaps the Lakeland fold north of Mt. Uniacke.
15. Pleasant Valley. Side fold on Upper Rawdon fold.
16. Central Rawdon. In slate, local.
17. McKay's Settlement — West Gore. Almost hidden by Coal formation.

In a section reaching across the eastern end of Halifax County near the Guysboro County line there are 12 folds as follows :—

1. Harbor Island or Southern Anticline. Seen on a few islands.
2. Tangier — Harrigan Cove. Has many small side folds.
3. Salmon River—Little Liscomb Harbor. Goes west into the Mooseland granite.
4. Mooseland — Gegogan. Goes west into the granite back of Jeddore.
5. Wine Harbor. Flattens out in a syncline going west.
6. Goldenville—Killag—Gold Lake. Goes west into the Musquodoboit granite.
7. Moose River (south)—Beaver Dam—Stillwater.

8. Moose River (north). Fifteen Mile. Flattens out going east.
9. Forest Hill—Cochran Hill—Caribou.
10. Big Liscomb Lake. Joins Little Liscomb Lake at Upper Musquodoboit.
12. Upper Stewiacke. A local fold in slate.

In Lunenburg County, along the LaHave river, we have the following succession though owing to the wide cross synclines the ranges cannot be traced as easily as those to the east of Halifax.

1. LaHave. On the shore and the LaHave Islands. In slate.
2. Ovens—Green Island—Dublin Shore.
3. Tancook—Indian Path—Vogler's Cove. Runs west to Port Mouton.
4. Mahone—Northwest. Probably on same range as Mill Village.
5. Blockhouse—Bridgewater — Leipsigate, (and probably Fifteen Mile Brook.)
6. Gold River—Maitland. Joins No 5 at Leipsigate.
7. Caribou Lake — Wentzell's Lake — Prescott Lake.
8. Newbern — Pleasant River — Molega. Goes west probably to Sixth Lake.
9. New Germany Lake—Brookfield—Whiteburn. Reaches probably to Little Tobeatic.
10. Cherryfield—West Caledonia. Runs into the granite east and west.

To the west of this last section there are many scattered domes that may be gold bearing. They are usually oval in form, with deep cross synclines separating them from others east and west. They include Port Mouton, Broad River, Rush Lake, Sixth Lake, Little Tobeatic and one to the south west of Kejimkujik, and another to the west of Frozen Ocean near the granite. These have been but slightly prospected and may offer a profitable field of search.

In Yarmouth and Digby Counties, and especially the latter, the folds are long and regular. Beginning on the shore of St. Mary's Bay, we have the wide Weymouth fold succeeded to the south-east by the narrow Meteghan fold. Then comes the Hectanooga fold, on the south-west end of which Cranberry Head Gold Mine is located. This is succeeded by the Kemptville Tusket anticline. Another fold starting at Lower Argyle, runs north-east into the interior to the head-waters of the Clyde, Roseway and Jordan Rivers. These are the main folds, which with a few minor folds make up the gold series of Yarmouth and Digby Counties.

Much of this series especially in Southern Yarmouth and Shelburne Counties consist of hornblendic

gneisses and mica and talcose chists. These last Prof. Bailey considers to be the results of transformation by heat from the green slates, of which wide belts exist in Digby County. That they occupy the places formerly filled by the green slates there is no doubt.

The following diagrams are examples of the variety of form that the anticlines assume in Nova Scotia.

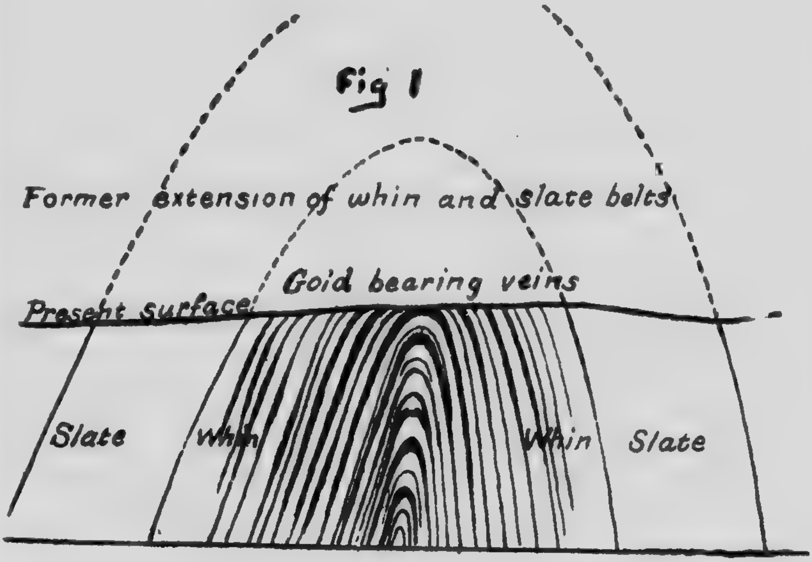


Fig. 1. Represents the ordinary form of an anticlinal fold in Nova Scotia, showing also the former upward extension of the fold before it was worn down to its present level.

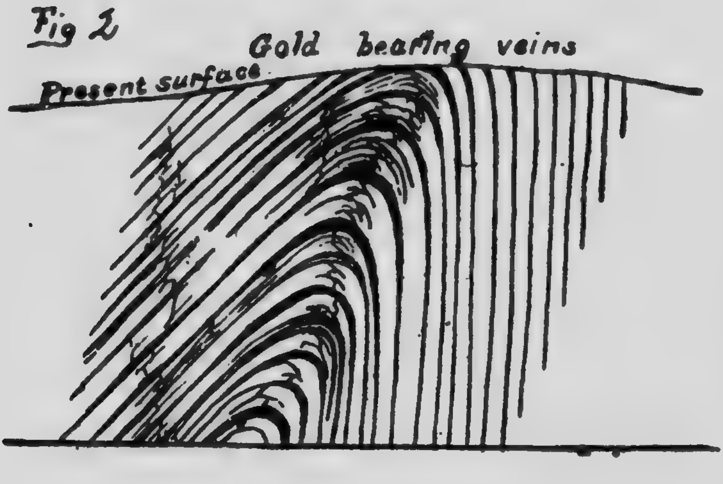


Fig. 2. Represents the form of the Goldenville anticline viewed from the west, showing it upset slightly to the south. It is on extensions or legs of the saddle like veins that past mining has been done.

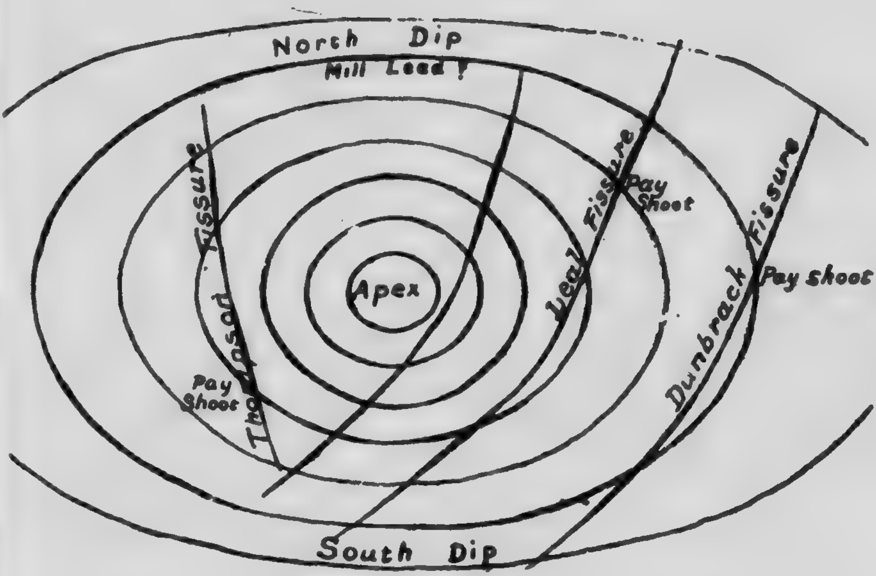


Fig: 3.

Fig. 3. Is a surface plan of the Pleasant River Barrens fold, showing cross and main leads.

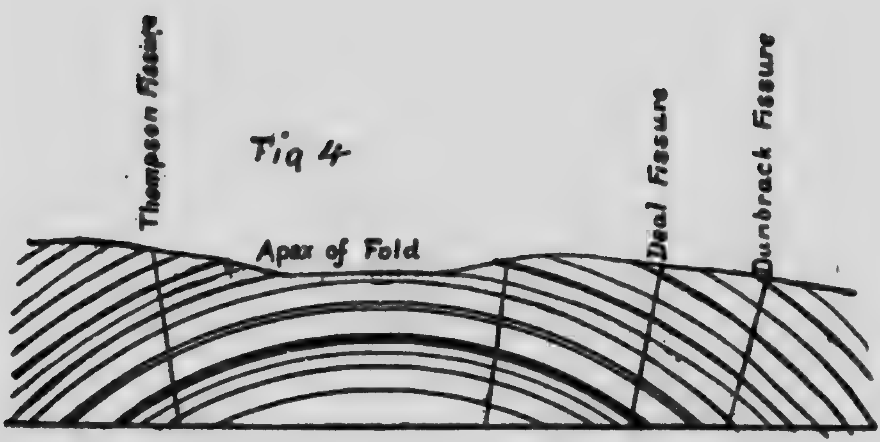


Fig. 4. Is a section across Pleasant River Barrens Gold District, showing the cross leads which form the rich spots by their junction with main leads.

Wide, continuous main leads are not usually found in folds of an oval or almost circular form such as at Pleasant River. In them you must look for fissure veins which are really cross leads or the junctions of these cross leads and main leads. A rich main lead on these circular folds is a rare exception. Such an exception is probably the McGuire lead of Whiteburn, Queens County.

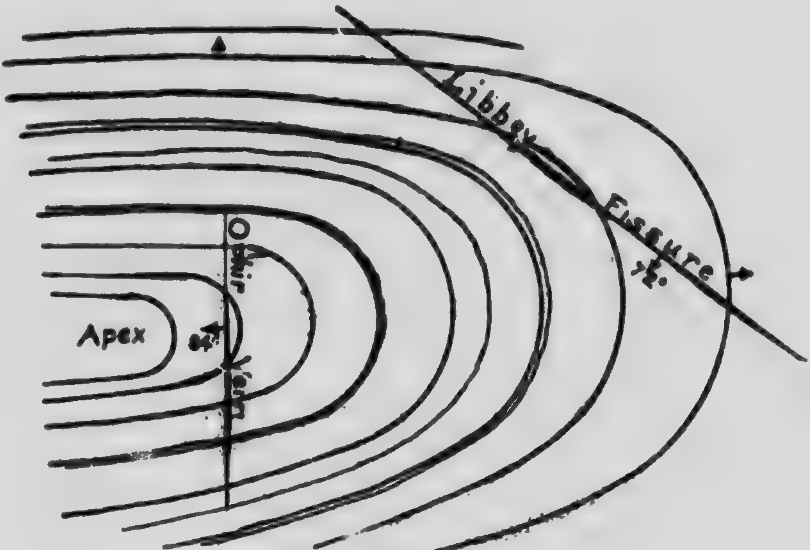


Fig. 5

Fig. 5. Represents the Brookfield fold, in which the chief leads are fissures. It approaches somewhat the Pleasant River form.

Fig 6

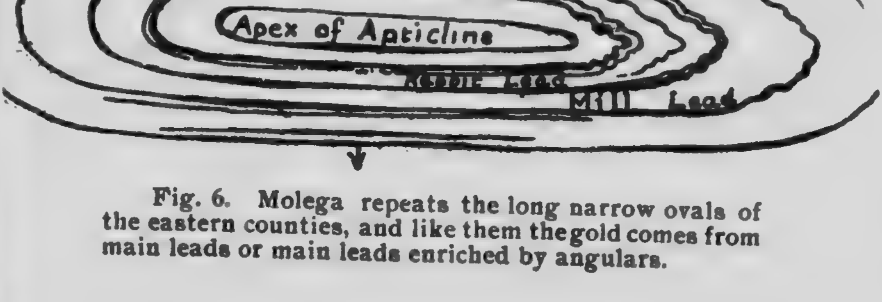


Fig. 6. Molega repeats the long narrow ovals of the eastern counties, and like them the gold comes from main leads or main leads enriched by angulars.

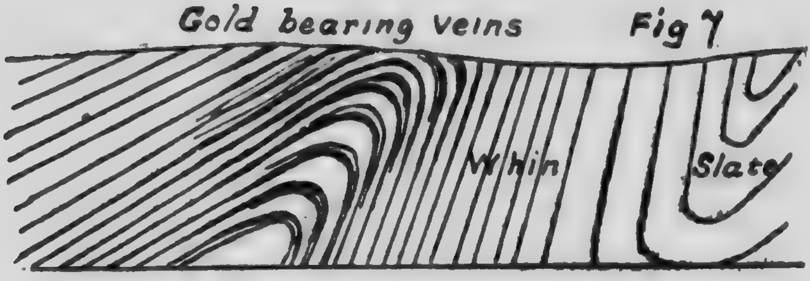


Fig. 7. Killag is an example of an overturned fold, a form confined to the Eastern Counties.

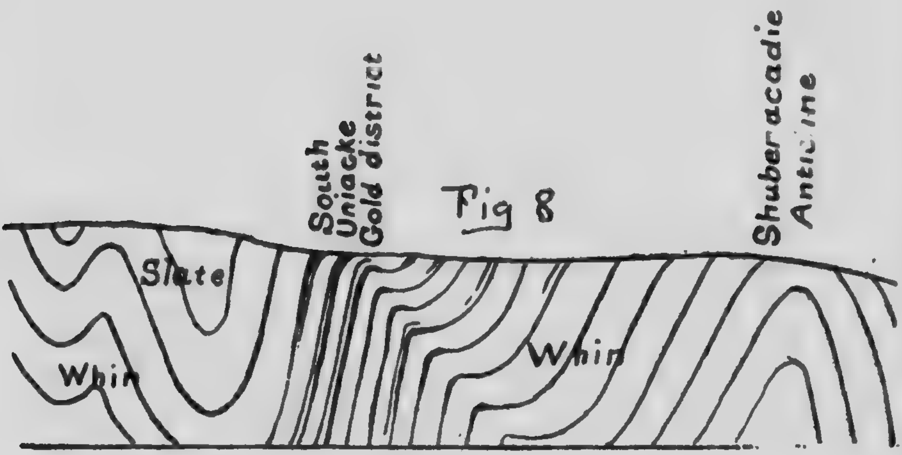


Fig. 8. South Uniacke is a crumple on the north side of a large fold, a form of which there are several examples in Nova Scotia.

In no part of the province can the succession of whin and slate be seen so well as on the Sissiboo River in Digby County. Neither the highest nor lowest beds can be seen, but the section several miles long shows well how the different beds succeed each other. Measurements can easily be taken because the purple slates, which occupy a clearly defined position in the series, make the position of the other rocks in this fine section unmistakeable. As a knowledge of the nature and order of these beds will be useful to the prospector I will here insert a table published by me in the 1894 number of the "Transactions of the N. S. Institute of Science. Though the thickness has been added to somewhat since then, no change has been found in the order of the different beds. The order here is the natural one.

13	Blue and bluish-grey slates Thickness	2,000 ft.
12	Black slates with white sandy seams	1,500 "
11	Bluish-black slates	2,000 "
10	Bluish-grey and ribboned slates	500 "
9	Upper greenish-grey slate	1,000 "
8	Upper purple slate	400 "
7	Middle greenish-grey slate	1,500 "
6	Lower purple slate	150 "
5	Lower greenish-grey slate	1,000 "
4	Bluish to greenish-grey whin and slate of same color	5,000 "
3	Upper bluish-grey quartzite and bluish-grey slate	3,000 "
2	Bluish-grey quartzite with graphitic slate	2,000 "
1	Lower bluish-grey quartzite with grey slate at bottom	6,000 "
	Total thickness about	26,000 ft.

The late explorations of Mr. Faribault in King's County has resulted in the discovery of a great thickness of slates. After a close examination he has decided that they belong to the upper part of the gold formation and add 4000 or 5000 feet to its thickness.

A little gold has been reported from there but whether it will prove a profitable field for the prospector, time and effort alone can prove.

In some of the Eastern districts the upper or lower purple slates are absent. In some of the Western districts the graphitic slates are absent. We can however be sure of one fact—viz—the order is never reversed.

The lowest bluish-grey quartzite (whin) is shown only in our very widest folds as at Moose River, Halifax County. No. 3 is specially developed on the Sissiboo. No. 5 in Queen's and Yarmouth Counties. No. 6 and 8 on the east shore of Kejama-kujid Lake. Nos. 10, 11 and 12 around Lunenburg town. No. 13 on the Sissiboo, and probably north of Caribou mines.

The thickness of the different beds are very vari-

able. A bed 2000 feet thick in one district may thin out to 200 feet in another district.

The ability to recognize these different beds often enables a prospector to locate a break when other means fail. Therefore I would lay stress on the necessity of studying the differences between these beds, so that one may be distinguished from another. Examine them under different conditions, wet, dry, polished and weathered, as these conditions often give a different appearance to the eye.

Two prominent features of the rocks of our gold fields are the bedding and cleavage. On small exposures of rock it is easy to mistake one for the other, therefore the utmost care is needed to distinguish them.

The bedding planes are often only distinguished by faint bands showing a slight difference in color, or by a crooked belt of rougher rock crossing the slates, or by a slightly weathered band showing a difference in hardness, but seldom by straight weather worn cracks, the usual indication as a rule, of cleavage.

The bedding planes in slaty, or partially slaty rock, are nearly always curved; while the cleavage planes are straight and nearly always parallel with the folds in the Eastern Counties. A curved cleavage plane I have scarcely ever seen in Nova Scotia, though Mr. Faribault reports some in the eastern extremity of the province. The cleavage has been caused by lateral pressure when the earth's crust was very rigid, and so has nothing to do with the bedding though often mistaken for it. Near the saddle of an anticline, as at Moose Lake in Mooseland, Cochran Hill, and elsewhere, the cleavage often opens dipping toward the centre of the fold. At Crows Nest the cleavage planes are said to be occupied by quartz veins holding mica, a sign of eruptive or metamorphic origin, and of later age than the gold bearing leads. This shows that the fold has been squeezed closer together since the cleavage was formed, a movement probably due to the disturbances and shrinkage of the granitic or metamorphic age at the close of the vein forming stage. Away from the saddles the cleavage is nearly always vertical unless shaken by frost or other surface influences, while the bedding planes dip in any direction.

CHAPTER IV.

The Gold Deposits of Nova Scotia.

The gold deposits of Nova Scotia may be divided into three classes.

1st. Main or bedded leads and their associated angulars.

2nd. Cross, or fissure leads as they are here called.

3rd. Gold bearing drift or conglomerate.

The first class includes most of the worked leads in Nova Scotia. They are usually grouped around the ends of anticlines where these folds pitch east or west. As a rule they are largest near or on the saddle of the fold, or at a sharp curve in the course of the beds. With rare exceptions they are never very far from an anticline or a sudden downward bend of the beds where these beds are made up of whin and slate, for there the conditions are most favorable for the formation of leads. Tne exceptions so far as I know are only three in number, the best proved example being at Lochaber on the East River of Sheet Harbor. Here, in the basin of a syncline where the slates came in, was worked several gold bearing leads which seemed to reach no deeper than the bottom of the basin. In or near the middle of a syncline at Westfield in Queens County, is the largest quartz vein in the province, 62 feet wide, but carrying very little if any gold. Here, through the cleverness of English and American adventurers was carried out one of the biggest swindles in the history of gold mining in Nova Scotia. I mention this as one of many like transactions by foreign promoters the results from which have been falsely placed to the credit of Nova Scotian mines and miners. At Chegogin in Yarmouth some mining has been done on a mineralized felsitic or quartzose belt nearly 200 feet wide, but with poor results.

The position of a zone of gold bearing rocks seems to have been decided by—a crumple, a belt of shattered rock, a sudden curve in the course of the belts, or the passage of a cross lead across the leads. While this zone of leads probably continues to great depths, the separate leads composing it peter out as their distance from the saddle increases. The leads now showing on the surface are merely the remnants of leads which once approached nearer to the saddle, and probably curved over it before erosion took place. Though the beds of slate and whin curve downward over the folds and come to the surface in the next fold, we cannot expect the accompanying leads to do the same. The

leads were formed only in places where the whin and slate have been subject to a strain which bent, folded, or cracked them; a strain caused by the cooling and shrinking of the earth's crust.

It may be noted here that the steepest side of a gold bearing anticline is nearly always the richest side, and often the only side carrying gold, though leads may be numerous on both sides.

We have in our gold districts this curious feature, that while a large fold may have every appearance of being a suitable location for a zone of gold bearing leads, yet it will be barren and almost destitute of quartz veins. Instead, a small side crumble, a part of the main fold of course, will contain rich gold bearing leads a quarter to two miles from the main or central fold. Examples of this are seen at South Uniacke, Harrigan Cove, and Isaac's Harbor. It may be that the crumple, which always dips toward the main fold, will become the main fold in depth, while the latter will shrink into a small side fold.

The second class of gold deposits consist of cross or fissure veins, such as the Libbey and Ophir of Brookfield and the Prest of Blockhouse, as well as the lead of West Caledonia. These cross the anticlines at various angles.

This class also include fissures like those at Leipsigate and Fifteen Mile Brook which run parallel with the folds near which they are located. Like the other fissures they dip toward the centre of the folds. All these show strong evidence of being workable to great but not unlimited depths. They will probably show pay streaks at their junction with every important main lead they cross.

Fissure veins have been worked at Cranberry Head, Vogler's Cove, Central Rawdon, Oldham, Lake Catcha, Caribou and Cow Bay, near Dartmouth, while several other leads of the same kind await the funds to uncover them.

The relation of gold bearing leads to anticlines is splendidly shown in Mr. Faribault's maps of the gold districts, and a short study of these maps will save the reading of many pages of description.

Deposits of the third class are formed by the wearing down and washing away of the first and second class of deposits. They consist of gold bearing sand and fragments of gold bearing quartz torn from the lead and mixed with drift material from the neighborhood. Those in Nova Scotia belong chiefly to the bottom of the coal formation. The rocks have been subject to intense wear and the gold has been sifted to the lowest layers, where its concentration often makes it rich enough to pay. The principal deposits of this kind are found at Gay's River and Brookfield in Col-

chester County, and Newport and other places in Hants County, but all need more extensive prospecting.

A more recently formed deposit of the same kind is the sea washed sands at the Ovens, Lunenburg County. Much work was done there in the 60's, but now it is only after a heavy storm or a long period of idleness that pay sand can be found. The source of it seems to be the small angulars in the cliffs near by or in ledges in the shallow water near the shore.

Nearly all our gold districts have gold bearing sands or clays in low places or near some of their richest leads, but it is rarely ever concentrated enough to pay for working. It is said that profitable washing of gold was carried on for a while at Middle River, Cape Breton, and probably the same could be done there again if the over burden of earth were removed.

The bottom of a small lake at Tangier is said to show evidence of rich alluvial ground. The ground around the rich lead at West Caledonia also shows rich pannings and would no doubt pay to mill as it can be got out very easily.

The surface from the Touquoy property at Moose River paid well to run through a fifteen stamp mill and many thousand dollars profit were made in that way by its enterprising owner.

But however enticing this easy work is, the prospector's principal work will be the search for some of the many rich leads that nature has hidden away for the use of our children or children's children.

CHAPTER V.

The Minerals of our Gold Fields.

In prospecting for gold in Nova Scotia many other minerals will be found, some of them of commercial value. Among those already found in the gold formations proper, are antimony, tungsten, and tin. The granite has produced manganese, iron, (limonite) and silver bearing galena, apparently in paying quantities. Other rare and valuable minerals may be looked for with good chances of success, such as platinum which in other countries is often associated with gold.

In the granite tracts, mica, molybdenite, and tourmaline are common, and farther may yet result in deposits of value. In the gneisses of Lunenburg many rare minerals in small quantities have been found and with these have been found also large quantities of quartz crystals of immense size, as well as kaolin possibly in paying quantities. Other veins contain feldspar, amethyst, agate, fire opal and a variety of rarer minerals. The lake bottoms in the same regions contain large deposits of infusorial earth, which has met with a limited market. At Chester Basin a large quantity of mineral paint or ochre has been found. Some has been shipped and manufactured and pronounced by the users as of fair quality.

Among the minerals of the gold bearing rocks is antimony. So far it has been found in paying quantities only in one place in the province—viz.—at West Gore, Hants County. This ore was exported for several years before it was known to carry gold. The attempts to separate the two metals at first did not meet with much success but recently a very satisfactory percentage has been recovered. The returns from 1905 to 1911 show 4512 oz. of gold from 3240 tons of ore.

The antimony is found in three forms, Stibnite Sb S_3) composing the bulk of the ore consisting of antimony 72 per cent., sulphur 28 per cent. Orange colored kermesite (Sb^2S^2O) found where the stibnite has been exposed, and white valentinite (Sb_2O_3) found here and there, are also ores of antimony. These ores often carry gold to the value of $200 per ton. It is intimately combined with the antimony, free gold being found only in cross veins.

Two veins, both fissures have been opened. They are from one to seven feet wide and run north 45 deg. west and dip south-west at an inclination of 85 deg. from horizontal.

The enclosing rock is whin and slate, chiefly the last, belonging to the lower part of the slate division of the gold series. This holds out the hope that other

deposits of gold bearing antimony may yet be found in Nova Scotia. So far as known, antimony except in the smallest quantities has not been found in bedded leads in Nova Scotia.

Tungsten is found in or near several of our gold districts but seldom or never directly associated with gold. The most common form in Nova Scotia is the ore known as scheelite, after which the new mining village west of Moose River Mines is called.

The first discovery of scheelite in Nova Scotia was made by me at Molega in 1891. Then in 1904 I found drift ore at Fifteen Mile Brook. This was followed by the discovery of scheelite west of Moose River in 1908 Other discoveries were made later near Waverley, Oldham, Huey's Lake, Lunenburg County, and in the tailings at Caribou Mines.

At Molega it was found in a small gash vein in one of the lower levels of the Ballou Mine. The Geological Survey Department at Ottawa identified the ore but gave no hint as to its value. The ore is found in bedded leads at Scheelite, as well as all the other places and is usually half to one mile from the gold bearing leads. At Fifteen Mile Brook only has it been found in any quantity near a gold producing vein. The discovery at Molega is only an indication. Beside the above at least two or three other discoveries of this mineral have been made but owing to uncertain interpretation of the law the finders are keeping the locations a secret.

Prospecting for tungsten has only just begun and much territory yet remains unexplored. The high price of the ore, $400 to $550 per ton, should encourage a search for it, and it will probably remain at the present figure for some time as the demand is greater than the supply.

The granite tracts, which interfere everywhere with the regularity of our anticlines, have lately been proved to be of more value than was formerly supposed. The fissures in the granites of Lunenburg County are the seats of some of the best manganese veins in the world. Several of the veins are known, all well defined and carrying the highest grade of manganese. It will average 98 or 99 per cent. pyrolusite. A reference to the table will give the appearance and quality.

These veins, located in the granite region between New Ross and Falmouth, run nearly east and west, are vertical in dip and are from one to six feet wide. In the same vein but not mixed with the manganese are separate layers of iron, limonite, which may prove of value as a by product if ever a railway passes there.

These discoveries, made within the last few years, have made valuable a hitherto worthless rock. Therefore the prospector may be wise in taking note of in-

dications of minerals when travelling over even so worthless a rock as granite was formerly supposed to be.

Iron, though commonly associated with gold as a sulphide, has not been found in the gold mines in paying quantities. But several large seams are known, notably at Molega and New Ulm, that are encouraging enough to bear development. In this form it is valuable as a source of sulphuric acid. Large beds of bog iron are found in various parts of the region underlaid by the gold bearing rocks, but hitherto they have not been turned to use.

Silver bearing galena is also one of the minerals now yielded by the granites of the gold series. It is found in well defined fissures apparently of considerable length and depth. A discovery made by Peter Dunbrack many years ago at Musquodoboit is now being developed. Another owned in Guysboro County shows every evidence of being a bonanza though undeveloped. Silver has been found in the galena of Smithfield. Colchester County, and also in the bricks of gold handed in from the gold districts, though in some cases I suspect it has been obtained by a too close scouring of the silvered amalgamating plates of gold mills.

However there seems to be a good field open for the discovery of silver in the granite tracts that cut our gold fields.

Among the various minerals found in our gold-bearing veins are lead, copper, nickel, antimony, cobalt, zinc, iron, silver, arsenic and probably bismuth. They are usually combined in the various ores known as galena, copper pyrites, niccolite or millerite, stibnite, cobaltite or smaltite. zinc blende, iron pyrites, marcasite, mispickel, pyrrhotite &c. So far they have been of no commercial value. Platinum should be specially searched for as it is found associated with gold in other countries. Our granites and gneisses, having been proved to contain tin, a prospector's time may be well repaid by a more extended search than has heretofore been made. A large tract of these rocks occupies the interior of Shelburne, Yarmouth, Digby and Annapolis Counties. and have been but slightly explored.

CHAPTER VI.

How to Distinguish Minerals.

The minerals in the following table are confined to such as are or may be found in Nova Scotia. Mere field tests, and a few others inclnded on account of their simplicity, are all that is needed. An outfit for even a qualitative test is more than a prospector has time to bother with if he pursues the problems of rock structure and drift dist ibution as far as he should. Any ore of a complicated or uncertain character should be tested by an assayer. Technical terms are avoided wherever it is possible to use common words of the same meaning. A short glossary will explain what cannot be substituted. The composition, when too long for insertion here, will be found in Dana's Mineralogy.

Mineral	*Iron Pyrite*	*Marcasite*	*Mispickel*	*Chalcopyrite*	*Smaltite*
Color	Brass yellow	White or light yellow	White or light grey	Bright yellow or variegated	Tin white to steel grey
Streak	Greyish black or greenish black	Grey to black	Dark greyish black	Greenish black	Greyish black
Lustre	Metallic	Metallic	Metallic	Metallic	Metallic
Structure	Massive and in cubes	Massive and granular	Massive and granular	Massive and crystallized	Massive and crystallized
Fracture	Brittle. Uneven	Brittle. Uneven	Brittle. Uneven.	Uneven	Brittle. Uneven
Hardness	6 to 6.5	6 to 6.5	5.5 to 6	3.5 to 4	5.5 to 6
Gravity	4 8 to 5. 2	4.6 to 4 8	6 to 6.4	4 to 4.3	6.4 to 7.2
Composition	Fe 47. S 53	Fe 47. S 53	Fe 34. S 20. As 46	Fe 30. Cu 35. S 35	As 72. Fe 9. C 9½. N 9½
Knife test	Slightly scratched	Slightly scratched	Slightly scratched.	Easily scratched.	
Remarks	Strikes fire	Rusts easily	Strikes fire	(Copper Pyrite)	

Mineral	*Pyrrhotite*	*Niccolite*	*Galena*	*Copper Glance*	*Cuprite*	*Stibnite*
Color	Bronze yellow to reddish yellow	Pale to dark copper red	Bluish grey	Dark lead grey with green stains	Red of various shades	Lead grey to steel grey.
Streak	Dark greyish black	Pale brownish black	Bluish grey or lead color	Blackish lead grey	Brownish red and shining	Lead grey to steel grey
Lustre	Metallic	Metallic	Shining	Metallic	Sub metallic	Metallic
Structure	Granular	Massive and fibrous, Reniform	Granular and in cubes	Compact Massive Granular.	Massive, Granular, Fibrous	Massive, Granular, Columnar.
Fracture	Brittle uneven	Brittle uneven	Flat very brittle	Curved and uneven	Curved and uneven. Brittle	Curved and uneven, Brittle.
Hardness	3.5 to 4.5	5. to 5.5	3.5 to 3.7	2.5 to 3	3.5 to 4	2.
Gravity	4.4 to 4.7	7.3 to 7.7	5.5 to 5.8	5.5 to 5.8	5.8 to 6.2	4 5.
Composition	Fe 60. S 40	As 56 Ni 44	Pb87 S13	Cu80 S20	Cu 89, O 11	Sb 72. S 28.
Cleavage			Perfect			Good.
Scratched by a knife	Easily		Easily	Easily	Easily	Easily
Remarks	(Magnetic pyrites) Attracts compass needle Composition varies some	(Copper nickel) Antimony often replaces the arsenic, giving Sb 68 Ni 32	(Lead sulphid) Often carries silver. One of the best indications of gold.	(Chalocite) (Copper Sulphide) Sometimes, but rarely, crystalized.	(Red Copper ore) (Copper oxide) Sometimes nearly black or earthy with iron	(Grey Antimony) (Antimonite) Associated with gold in Nova Scotia.

Minerals	*Bismuthnite*	*Millerite*	*Cinnabar*	*Molybdenite*	*Argentite*	*Native Bismuth*
Color	Lead-grey to tin white	Brass-yellow to bronze-yellow.	Usually red, [illegible]ish red, grey	Shining lead-grey or darker.	Dark lead-grey	Silver white.
Streak	Lead-grey to tin white	Bright yellow	Scarlet	Lead-grey or slightly green	Shining lead color	Silver white.
Lustre	Metallic.	Metallic	Dull Flinty	Metallic	Metallic	Metallic.
Structure	Massive, Fibrous, Foliated	Columnar. Radiated	Massive, Granular, Friable	Usually in scales. Flexible	Massive, Fibrous	Foliated and granular.
Fracture	Uneven.		Uneven, slightly curving	No fracture of note	Malleable	Brittle.
Hardness	2	3 to 3.5	2 to 2.5	1 to 1·5	2 to 2.5	2 to 2.5.
Gravity	6.5 to 7.2	4.6 to 5.6	9	4 to 4.8	7.2 to 7.4	9.7
Composition	Bi 81, Si 9.	Ni 64, S 36	Hg 86, S 14	Mo 59, S 41	Ag 87, S 13	Pure bismuth.
Cleavage	Perfect	Perfect	Good	Perfect	None	Perfect.
Scratched by a knife	Easily	Easily	Very Easily	Scratched by nail	Very easily	Very easily.
Remarks	(Bismuth glance) Tarnishes yellow	Tarnishes to grey. Partly reniform	(Quicksilver ore) Sometimes mixed with iron rust, clay, &c.	Very soft. Sometimes finely granular or massive. Marks on paper. Found in Granite Gneiss, &c.	(Silver glance. The only silver ore, except native silver, that is malleable.	Found in veins in gneiss and other eruptive and crystalline rocks.

Minerals	*Graphite*	*Bornite*	*Zinc Blende*	*Cobaltite*	*Corundum*	*Tinstone*
Color	Iron black or dark grey	Copper-red to brown. Variegated	Usually black brown red yellow, &c.	Usually silver white to steel grey	Usually white, yellow, grey, blue, red, brown	Brown or black Rarely red or grey.
Streak	Black and shining.	Pale greyish black	White to reddish-brown	Greyish-Black	Uncolored	White, grey or brown
Lustre	Metallic	Metallic	Resinous to flinty	Metallic	Glassy	Dull flinty.
Structure	Massive, Granular, foliated	Massive Granular. Compact	Massive. Rarely fibrous	Massive. Granular	Massive. In layers. Finely granular	Massive. Granular. Fibrous
Fracture	Ragged, Flexible	Uneven. Brittle	Flat and curving. Brittle	Uneven and flat. Brittle	Uneven, somewhat curving	Uneven Brittle.
Hardness	1 to 2	3.	3.5 to 4	5.5	9	6 to 7.
Gravity	2.1	4.4 to 5.5	3.9 to 4.2.	6 to 6.3	3.9 to 4.1	6.4 to 7.1.
Composition	Pure carbon	Cu 56, Fe 16, S 28	Zn 68, S 33	Co 36, As 45, S 19	Al 53, O 47.	Sn O.
Cleavage	Good	(?).	Perfect.	Perfect	Not perfect	Indistinct.
Scratched by a knife	Scratched by finger nail	Easily	Scratched	Hard to scratch	Not scratched	Not scratched.
Remarks	(Plumbago) Peels greasy. Sometimes has a little iron. In granite, gneiss, schist	(Purple Copper ore) Tarnishes purple	(Black Jack) Sometimes white and green Usually black, often with galena.	Is greyish-black when containing much iron	Very tough. One of the hardest substances known. Emery includes iron and corundum	Cassiterite, Often reniform and radiated or fibrous In perfect crystals in granite

Mineral	*Hematite*	*Menaccanite*	*Magnetite*	*Chromite*	*Pyrolusite*	*Wad*
Color	Dark grey to iron black	Usually iron black	Iron black	Iron-black to brownish black	Iron-black.	Dull black or brownish black
Streak	Dark red to reddish brown	Black to brownish red	Black	Brown	Dark grey or bluish. Black to bluish black	
Lustre	Metallic	Sub-metallic	Metallic	Sub-metallic		
Structure	Granular. Columnar. Foliated.	Massive or in thin plates	Massive. Granular	Usually massive	Massive. Granular. Radiated	Massive. Earthy Brittle
Fracture	Uneven	Curving and shining	Uneven. Partly curving. Shining	Uneven. Brittle	Uneven. Brittle	
Hardness	5.5 to 6.5	5 to 6	5 5 to 6.5	5 5	2 to 2.5	½ to 6
Gravity	4.5 to 5.3	4.5 to 5	4.9 to 5.2	4.3 to 4.6	4 8	3 to 4.3
Composition	Fe 70. O 30	Varies	Fe 72. O 28	Fe. O. 32. Cr. O. 68	Mn. 63. O. 37.	Much mixed with other ores Mn O.
Cleavage	Indistinct	Perfect	Good	None	Indistinct	None
Scratched by a knife	Hard to scratch	Very hard to scratch	Very hard to scratch	Very hard to scratch	Easily	
Remarks	(Specular iron) Often contains titanium. Sometimes magnetic	(Titanic iron ore) Often mixed with manganese and aluminum. Slightly magnetic	(Magnetic iron ore) Often contains titanium. Strongly magnetic. Usually in eruptive rocks	(Chromic iron ore) Magnesia often present. Sometimes magnetic	(Manganese ore) Often crystallized. Soils the fingers Leaves a mark on paper. Found in granite and limestone.	Bog manganese. Earthy, making it appear very light and soft. In wet valleys and brooks. Always on or near the surface.

Minerals	*Platinum*	*Limonite*	*Scheelite*	*Wolframite*	*Azurite*	*Malachite*
Color	Whitish steel grey, shining	Brown to brownish yellow	Usually white and grey, yellow to red	Dark grey. Brownish-black	Various shades of blue	Bright green
Streak	Whitish grey, shining	Red to yellowish brown	White	Dark reddish-brown to black	Lighter than color	Pale green
Lustre	Metallic	Silky to dull	Glassy	Sub-metallic	Glassy	Dull to glassy
Structure	In grains or small lumps	Fibrous usually Massive. Earthy	Massive. Granular	Massive. Granular. Lamellar	Massive and earthy	Massive. Granular. Fibrous. Earthy.
Fracture	Hackley or ragged. Malleable	Smooth	Uneven. Brittle	Uneven or slightly curving	Curving. Brittle	Uneven. Slightly curving.
Hardness	4 to 4.5	5 to 5.5	4.5 to 5	5 to 5.5	3.5 to 4 2	3.5 to 4
Gravity	16 to 19	3.6 to 4	5.9 to 6	7.1 to 7.5	3.5 to 3.8	3.7 to 4
Composition	With iron and other metals	Fe O 86. Water 14. Impure	WO. 80½. Lime 19½	WO. 76½. FeO 9½. MnO 14	CO 26. CuO 69. Water 5	CO 20. Cu O 72. Water 8.
Cleavage	None		Distinct	Perfect	Perfect.	Very perfect.
Scratched by a knife	Hard to scratch	Hard to scratch	Can be scratched	Easily scratched	Easily scratched	Easily scratched.
Remarks	Magnetic occasionally. Found in gold regions.	(Brown Hematite) Has rounded surfaces black outside Often seen as yellow ochre or bog iron	An ore of tungsten. Often yellowish-brown, reddish and greenish Found in gold fields	An ore of tungsten. Sometimes weakly magnetic, owing to presence of iron	(Blue Copper Ore) Often with galena. Not usual in gold mines	(Green Copper ore) Often with smooth, warty surface. Sometimes banded. Found in N. S. gold mines.

Minerals	*Siderite*	*Hornblende*	*Feldspar*	*Calcite*	*Quartz*	*Talc*
Color	Usually whitish to yellowish and ash grey	Usually black. Often other colors	Usually pink or yellowish white	Usually colorless and white grey-red &c	Colorless. White Various	Usually white to greenish grey.
Streak	White	Paler than color	Pale or uncolored	White or light grey	Lighter than color or white	Lighter than color.
Lustre	Glassy to pearly	Glassy to pearly	Glassy to pearly	Glassy to earthy	Glassy	Pearly
Structure	Massive. Granular. Often fibrous	Massive. Granular. Fibrous	Massive. In cubes.	Lamellar. Granular. Fibrous	Massive or crystallized compact	Massive. Foliated. Granular. Radiated.
Fracture	Uneven	Uneven. Tough Brittle. Friable	Straight to uneven. Brittle	Curving to uneven. Brittle	Curving. Tough Brittle.	Ragged. Uneven.
Hardness	3.5 to 4.5	5 to 6	6 to 7	2.5 to 3 5	7	1 to 1.5.
Gravity	3.7 to 3.9	2.9 to 3·4	2.5 to 2.9	2.5 to 2.8	2.5 to 2 8	2.5 to 2 8.
Composition	CO 38. FeO 62.	Various minerals in varied quantities	Varied	CO. 44 CaO 56.	Si 47 O 53	SiO 63½ MgO 31½ water 5.
Cleavage	Perfect curved.	Highly perfect	Perfect	Perfect	None	Perfect.
Scratched by a knife	Easily scratched	Hard to scratch	Not scratched.	Easily scratched	Not scratched	Scrat-·ed by finger nail.
Remarks	(Spathic iron) Surface often globular. Often greenish grey and reddish brown.	(Amphibole) Includes Mn, Mg, Ca, Fe, Na, K, Al, Si, H, and O. Often lamellar, fibrous and radiated Often silky	Labradorite is the most valuable of the feldspars from its play of colors Of many light colors.	(Calcspar) Abundant in the leads of some gold districts. Various tints of red, blue, green, yellow. Brown and black when impure.	(Silica) Amethyst, False topaz, Catseye, Chalcedony, Carnelian, Agate, Jasper, Flint, Sardonyx Onyx, Chrysophrase are all varieties of quartz	(Soapstone) Feels greasy. Usually in layers. Can be cut with knife. When massive, dishes can be made of it.

Mineral	*Dolomite*	*Mica*	*Kaolinite*	*Tourmaline*	*Garnet*	*Opal*
Color	Usually white. Reddish to greenish white	Colorless to yellowish brown Black	White. Grey. Yellow to brown	Brown, black most common	Usually deep red. Black &c	A great variety of changing colors.
Streak	White	Colorless to greyish green		Uncolored	White	White.
Lustre	Glassy to pearly	Glassy to pearly	Pearly	Glassy	Glassy to resinous	Glassy to resinous or pearly.
Structure	Massive. In grains	Foliated. Flexible	Claylike. Friable. Mealy	Columnar. Compact. Massive	Crystallized	Massive. Reniform.
Fracture	Brittle			Curved. Uneven Brittle	Uneven. Partly curved. Brittle	
Hardness	3.5 to 4	2 to 3.5	1 to 2.5	7 to 7.5	6.5 to 7.5	5.5 to 6 5
Gravity	2.8 to 2.9	2 7 to 3.1	2.4 to 2.6	2.9 to 3.3	3.1 to 4.3	1.9 to 2.3.
Composition	CaCO 54 MgCO 46	Varied oxides of 4 to 10 elements	SiO 46, AlO 40 Water 14	Varied. Oxides of 10 to 12 elements	Varied. Oxides of 3 to 8 elements	Si O. Almost pure quartz.
Cleavage	Perfect	Perfect		Poor	Uncertain	
Scratched by a knife	Easily scratched	Easily scratched	Scratched by finger nail	Not scratched	Not scratched too hard to scratch	Hard to scratch.
Remarks	(Magnesian limestone.	Some varieties violet-grey, lilac, pale to dark-green and smoky. Valuable when colorless.	Related to Saponite. In scales and plates Flexible.	Valuable when in rich tints of blue, green and red. Black is mistaken for hornblende.	Many varieties. Chrome garnet, Iron garnet, Almandite &c	Many varieties. Precious and Fire opal alone show changing colors. Found in N. S.

Mineral	*Granite*	*Syenite*	*Gneiss*	*Schist*	*Trap*	*Diorite*
Color	Usually grey to light red	Usually grey. Often red	Usually dark grey to reddish	Usually grey, greenish, yellowish	Usually brown, black	Darker than Syenite and granite.
Streak	White	White	White to grey	Lighter than color	Lighter than color	Lighter than color.
Lustre	Dull to glassy	Dull to glassy	Dull to glassy	Dull glassy to pearly and shining	No lustre	Dull to Glassy.
Structure	Crystallized. Massive. Coarse grained Brittle	Crystallized. Massive. Coarse-grained. Brittle	Crystallized Stratified. Coarse grained. Brittle	Stratified and contorted. Wavy	Massive. Fine-grained. Tough	Crystallized. Massive Coarse to fine-grained. Brittle.
Fracture	Rough and uneven	Rough and uneven	Rough and uneven	Uneven	Rough and uneven	Rough and uneven.
Hardness	Uneven	Uneven	Uneven	Uneven	Often very hard	....
Gravity	2.5 to 2.6	2.6 to 2.8	2,5 to 2.8	2.4 to 2.6	2,8 to 3,2	2.6 to 2.8.
Composition	Quartz Feldspar & Mica or Hornblende	Feldspar, Mica or hornblende	Like granite or Syenite	Quartz & Mica usually. Often Quartz and Talc	Varied. Contains many minerals	Same as Syenite

Mineral	*Granite*	*Syenite*	*Gneiss*	*Schist*	*Trap*	*Diorite*
Cleavage	Good	Good	Good	Perfect	None	Good.
Scratched by a knife.				Easily	Easily	
Remarks	Red granite not common. Mica often replaced by hornblende.	Mica often replaced by hornblende.	Contains many minerals of value.	Includes Chloritic schist, Hornblende schist. Often full of garnets.	Volcanic. Contains many minerals, some of value.	Hardly distinguishable from syenite.

In order to make full use of the foregoing table it is necessary to know how to decide the hardness and gravity.

To decide the degree of hardness the prospector should have a set of minerals beginning with the softest and ending with the hardest. For this purpose a list of minerals, ten in number, is given. These should be as pure as possible, well crystallized specimens being chosen, with flat surfaces on which scratches made by harder minerals can be seen. In using them use the harder specimens of your set first, to scratch the mineral you are testing whenever possible, coming at last to the specimen that will leave no mark. Scratch your samples with the unknown mineral as little as possible. It may be hard to secure a set of good samples showing the scale of hardness from this province but they are kept in stock by any dealer of minerals such as Wards Natural History Rooms, Rochester, N. Y.

1.—Talc. Found in the granite of N. S or at Wycocomagh, C. B.
2.—Gypsum. Found at Windsor, or Dutch Settlement, Halifax, N. S.
3.—Calcite. Found in the gold mines, especially at Gold River, N. S.
4.—Fluorite. Found in quarries at the Strait of Canso, N.S.
5.—Apatite. " " mines in Eastern Ontario.
6.—Feldspar. " " the granite of N. S.
7.—Quartz. " " " gold mines of N. S.
8.—Topaz. Get from a dealer.
9.—Corundum. Found in the mines of Eastern Ontario.
10.—Diamond. Get from a dealer.

It will be possible to get along with the samples from 1 to 7 as there may not be in Nova Scotia many minerals harder than quartz. Still the whole set will be supplied for a very reasonable price by a dealer.

Minerals with a hardness of 1 or 2 can be scratched by the finger nail. Those with a hardness equal to No. 3 cannot be scratched by the finger nail, but can be cut by a knife quite easily. Those with a hardness of 4 are not easily cut, but may be scratched by a knife. It is hard to scratch with a knife a mineral whose hardness is 5, and almost impossible to scratch one with a hardness of 6. Beyond this you must use one of the samples of your scale of hardness.

By Gravity, or Specific Gravity, is meant the number of times the mineral is heavier than water. It is possible to judge after experience slight differences of weight in the hand but this method is not exact enough to aid in identifying unknown minerals as a rule.

A small balance scale, such as druggists use, can be used in this test. Shorten the strings on one of the pans 2 or 3 inches. Pierce a hole through this pan through which you will put a hair or a silk thread. To

this hair or thread tie the specimen so that it will hang below the surface of dish of water setting beneath the pan. Note how much the mineral weighs under water. Then take off the hair and weigh the mineral in the pan of the scale. Note the weight again. Then subtract the lower from the higher number and divide the difference into the higher number. The answer will be the Specific Gravity, or the number of times the mineral is heavier than water of equal bulk.

Thus for example if the mineral weighs 66 grains in water, and 78 grains out of water, divide the difference 12 into the weight in air which is 78. The answer 6.5 will be the number of times the mineral is heavier than an equal bulk of water. Therefore its gravity is said to be 6.5. To get the weight per cubic foot multiply the weight of water, 62.5 lbs., by the gravity of the mineral. Thus galena will average about 468 when pure.

If these tests do not prove your sample you will have to put it through others requiring more care, time and implements. Unless the prospector has the time to spare he should hand the mineral to a competent assayer. If however he has a liking for the work he will find it to his advantage to take a night course at the Halifax Technical School, where the cost is a mere trifle. If he cannot do that Appleton's Short Course in Qualitative Analysis will be a help to him.

As the beginner is apt to mistake some minerals for others having the same appearance, a list is given of those looking somewhat alike especially when in small particles.

1.—Native gold, native copper, copper pyrites, iron pyrites, oxide of tungsten.
2.—Native silver, bismuth, mispickel, white mica.
3.—Quartz, feldspar, calcite, fluorspar, cryolite.
4.—Graphite, molybdenite.
5.—Apatite, beryl, chrome garnet.
6.—Galena argentite.
7.—Malachite, garnierite, pimelite.

Chapter VII.

Granite and its Influence on the Gold Series.

A large portion of what is often called the Gold Series of Nova Scotia is in fact granite, and quite barren of gold. This granite, with its associated gneisses and schists, takes up nearly half the space allotted to the series.

The largest tract is that beginning within 3 miles from Halifax and reaching nearly to Yarmouth. Adjoining and intermixed with this are large areas occupied by gneiss and schist, especially in Shelburne and Southeastern Yarmouth Counties. Approaching Yarmouth some belts of rock are almost pure hornblende, while around Pubnico talcose schists are prominent. In Lunenburg large areas of gneissoid rocks are seen.

Another granitic tract is that reaching from 2 miles east of Waverley gold district almost to Sheet Harbor. There are several others in Eastern Halifax and Guysboro Counties.

One very noticeable feature is that while the gold measures in Eastern Guysboro have been very violently disturbed, the rocks farther west especially in Yarmouth and Shelburne counties have been fused in place.

There seems to be the strongest evidence that the Nova Scotia granites, gneisses and schists, were formed from the whin, slate, and other stratified rocks at a time when the latter were several thousands of feet beneath the surface of the earth. It is not denied that there may have been a deep-seated core of molten granite formed from some older and lower rock, but there is too much evidence of the quiet fusing of our gold bearing rocks in place to allow the classing of granite in Nova Scotia as a purely eruptive rock.

Large sections of anticlines have in many instances disappeared in a body of granite, leaving the remaining sections of the anticline in their original positions and almost undisturbed. A study of Mr. Faribault's maps showing numerous cases of this kind should be convincing.

The progress of the melting process in all its stages is well seen in Yarmouth and Shelburne Counties. First there are slightly baked slates with minute specks of mica through them, then smooth and wavy micaceous and talcose schists and heavily bedded gneiss and a gradual change of both into granite. In Eastern Guysboro County also, we see the gradual change from clay slate into mica schist.

It is claimed by some authorities that granite subject to heavy lateral pressure has been turned into

gneiss and schist, and that whin has also been turned into gneiss under the same conditions. I have seen no undoubted evidence of this in Nova Scotia though such may exist.

Where the gold bearing rocks are in widely extended tracts they seem to have been quietly melted in place without disturbing much, the regularity of the surrounding anticlines Large districts once composed of whin and slate have been thus absorbed.

The granite in its molten state was probably injected into every available fissure, open bedding, or cleavage plane. In this way it would probably become associated with quartz as in a vein at Cochrane Hill, mentioned by T. A. Rickard. It would even open for itself, between layers of stratified rock, large deep-seated cavities known as batholiths.

These when laid bare by erosion would furnish a foundation for the old belief in the eruption of the granite on a huge scale over the gold bearing rocks.

In opposition to this theory of comparatively quiet fusion of the gold bearing rocks, we see evidences of the most violent dislocations in the province from Country Harbor east to Canso. This was accompanied by the fusing into granite of a large part of the gold series there, and the moving around of a large section of the Cochrane Hill—Forest Hill anticline.

Recent enquiries and investigations into the nature and surroundings of the Upper Country Harbor anticline leads me to the opinion that it was a portion of the next fold to the south. Being on the east side of the great Country Harbor fault where all the other folds are thrown to the north, it would reasonably be thrown in that direction also. All the evidence seems to me to point to this conclusion.

It seems that the smaller tracts of gold bearing rocks, being neither of great depth nor size, were moved about on a sea of molten granite, so to speak, while the large tracts were fixed and immovable because of their weight and bulk. There seems to be no doubt that nearly all these folds were continuous for long distances before interruption by the granitic metamorphism.

As to the time when this melting process took place there is evidence to show that it was one of the last acts that gave the gold bearing rocks their present structure and distribution.

1st. It was later than the folding of the anticlines.

2nd. It was later than the formation of the gold producing leads.

3rd. It was later than the largest and most important faults. (One fault, that of Indian Harbor Lake still remains in doubt.)

4th. It was later than the formation of the cleavage.

5th. It was later than the shell bearing rocks (Oriskany) of Bear River, which were laid on top of the gold bearing rocks. As however the age question has little to do with the main purpose of this compilation we will drop it.

A more important question is the influence of the granite in displacing the anticlines, altering their pitch, dip, and strike, causing breaks in the leads, cutting them off, or influencing them in any other way that may affect mining and prospecting.

There appears to be no doubt that the granite in cooling shrank, and that this shrinkage has caused displacements and faults in the surrounding rocks is only reasonable. If so can we see evidence of these disturbances in our gold fields? As one of the chief points in the training of a prospector is a knowledge of local details, I shall give instances where anticlines have been broken and drawn inward, apparently by the shrinkage of the cooling granite. Only the Eastern Counties are considered, as the Western Counties have not yet been thoroughly examined. The Montague, Lawrencetown, and Lake Catcha anticlines have the east ends drawn north. At Beaver Dam nearly the whole district has been broken and drawn south toward the granite. The Mooseland fold was broken and drawn south west toward the granite. The Crow Harbor fold in Guysboro County was drawn south toward the granite. The Big Liscomb Lake and Little Liscomb Lake anticlines were broken, drawn north and partly absorbed by the granite at Bottle Brook and Seventeen Mile Stream. The fold on the east side of New Harbor River was broken and drawn north towards the granite. The Upper Country Harbor anticline was also dislocated and drawn far out of its original position.

Another class of examples show a decided pitch of the folds either east or west toward a granite mass near by. In most cases the nearer the approach to the granite the more decided is the pitch of the anticline and the dip of the whin and slate belts toward it. The great majority of the anticlines that are crossed by granite tracts show its influence in this way.

Beginning with the great granite region west of Halifax City and the line of the Dominion Atlantic Railway, (C.P.R.) we see ten anticlines and six synclines pitching toward it, and only one syncline pitching away from it. At Long Lake north of Windsor junction is a small granite tract with one anticline and two synclines pitching toward it. At Aspotogan, Lunenburg County an anticline pitches toward the granite. Back of Musquodoboit Harbor and Jeddo e is the central part of the

Mooseland-Waverley granite tract with three anticlines and one syncline pitching toward it. The Beaver Dam tract has one anticline pitching toward it, and in its neighborhood, near Seven Mile Stream and Ten Mile Lake, are four anticlines and two synclines pitching in the same way. At Lake Major, at the Western end of the Mooseland-Waverly tract of granite, one anticline and one syncline pitch toward it. At Twenty Mile Stream one anticline pitches toward the granite at the head of St Mary's River. In the Tor Bay-Canso region we see two anticlines and three synclines pitching toward the various granite tracts there.

In contradiction to this, we see near Sheet Harbor two anticlines and one syncline pitching away from Mooseland granite tract. West of Mooseland one anticline pitches in the same way. At Waverley one anticline pitches away from the granite there while a few miles east two anticlines and one syncline also pitch away from it. At or near Ellershouse Hants County one syncline pitches in the same way. North of Beaver Dam on Seven Mile Stream one anticline pitches east away from the granite.

Thus we have a total of thirty nine anticlines and synclines pitching toward the granite tracts which cross them and only nine pitching away from the granite.

Taking up the inclination sidewise of the anticlines, we find that nine are upset toward the nearest granite tract while three are upset away from any granite near enough to have any influence. Of these last, the Killag inclined fold may be excluded as it is upset for nearly its whole length, even outside of any granite influence.

Those upset toward the nearest granite are,—Two anticlines east of Mooseland upset south, one anticline at Mulgrave Lake upset south. One anticline, the Cochran Hill, upset south toward the granite east of Twenty Mile Stream. One anticline Big Liscomb Lake upset south toward granite near the foot of Big Liscomb Lake. Two anticlines at, and a little north of Beaver Dam Mines, upset south toward granite. One anticline near Lower Caledonia Guysboro County upset south toward granite. One anticline at Archibald Lake Guysboro County upset south.

Those upset in the opposite direction-viz-away from the granite are,—the Little Liscomb Lake anticline, upset to the south at Bottle Brook. The Killag anticline, upset to the south near the Mulgrave Lake granite tract. An anticline upset away from the granite near Ship Harbour Lake.

There are of course, other anticlines apparently upset away from as well as toward granite tracts, but the inclination may extend their whole length and in that

case would be owing to lateral pressure, and originated long before the disturbances caused by the granite.

The influence of the granite on the formation of gold bearing leads does not appear to have been very great, as these veins evidently had been formed or nearly formed before the age of the granite. Under the influence of the disturbances caused by the molten granite, seams and lines of weakness would be opened, to a slight extent at least, and the melted matter injected into them. Even gold bearing veins in the neighborhood of granite would probably be reopened, especially when in a seamy belt, and a new layer of mineral matter be added to it. According to T. A. Rickard and others, such leads with gold bearing quartz and granite side by side are seen at Forest Hill and Cochrane Hill. This however is no stronger evidence of contemporary formation than that the different layers of any other lead were all formed at the same time. It is well known by every miner that leads are often of different ages, the later cutting the earlier if crossing it, and it is also known that the different layers in a lead do not all contain the same minerals, that the solutions which filled the openings could not all come from the same source, nor at the same time. I have not yet seen in the Nova Scotia gold fields a purely gold bearing vein, or the gold bearing portion of a vein, of proved later formation or even as late formation as the granite. If such has been found in the stratified rocks of the gold series they will probably be found in the granite also and will alter considerably the outlook of the prospector and increase as well the area of the country he will work over.

It has been claimed by some that because gold bearing veins have been found piercing the edge of a granite tract that these veins were of later formation than the granite. These veins are to be seen at Moosland, Forest Hill, Upper Country Harbor and other places. So far as I have been able to examine them these leads gradually become more and more crystalline as they enter the granite, and finally assuming the appearance of pure granite disappear in its mass. The disappearance of some of the minerals of the gold bearing veins is noticed with the gradual development of mica, feldspar and other signs of metamorphism. A good example of the gold and mica bearing vein matter from this transition rock at Forest Hill is seen in the Provincial Museum at Halifax.

That the rocks were once stratified, and with their associated leads were gradually dissolved into a molten mass and re-crystallized as granite, seems to me quite plain. Where gold bearing veins are still visible in the granite, (the latter,) in all cases so far coming under my observation in Nova Scotia, has not lost

quite all the traces of its original stratified condition as whin or slate. Many of our gold bearing leads, for instance at Country Harbor, have been pierced and crossed by granite veins of a later date without at all altering the character of the former and their contents.

It is quite evident that the era of disturbance did not cease with the cooling of the granite for we have deep seated fissures in the granites of Lunenburg and Halifax Counties. Some of these have been filled with valuable ores, such as manganese, iron, silver bearing galena, zinc blende. etc. There is a probability of these fissures or faults extending into the adjoining slates and whins and carrying with them their ores and accompanying minerals. With these possibilities in view the scope of the prospector's work is enlarged.

In the Geological Survey Dept's map of Eastern Guysboro are indications that the Indian Harbor Lake fault has also faulted the granite tract to the northwest. If so the fault is of later formation than the granite, a fact of some importance to the prospector, as it would shift veins in the granite as well as in the whin and slate. However, good authorities have doubted the correctness of the survey of that particular area, so the question remains unsettled. Another fault, at or near the junction of the stratified rocks and the granite at Seven Mile Stream, Halifax County, is also a doubtful proposition, not enough information being available to decide its nature or its age.

CHAPTER VIII.

Faults and the Trouble They Give.

Faults, or breaks as miners usually call them, are often the cause of much trouble and loss of time and money. Of all the obstacles in a prospector's way faults are the one thing that cannot be considered beforehand and no estimates can be made for. They are accidents of nature and unless their existence is known beforehand they introduce into the problem an "if" so large that the success of a venture often becomes very doubtful. They break in unexpectedly and injuriously on a prospector's best calculations, change his programme and often wind him up, therefore they are treated at greater length than an ordinary reader would think necessary.

In preparing a prospecting plan, after getting your area lines, leads and whin and slate belts set down as correctly as possible the next most important items are the faults. Even though known faults are outside the area worked on, the fact that they point toward it, means that they may enter it and become a possible obstacle to success. At any rate their location, dip, and course should be noted as a guide because as a rule nearly all faults in a district have the same course if not the same dip. The cause and history of a fault is not so important as the fact that it is there and may interfere with your work. Therefore it is well on beginning work in a district to get posted as soon as possible. Find out the names of former prospectors and miners and question them, consult old plans, surface and underground, and prove them wherever possible by personal examination. Examine the country yourself as much to gain experience as to throw new light on the subject in hand. Underground plans on file at the Mines Office and the district plans published by the Geological Survey Dept. may also be found useful in this respect.

The faults that cut the gold fields of Nova Scotia have a general direction of north north-west, a course not quite at right angles to the course of the anticlines. Some reach across nearly the whole width of the gold series, a distance of from 20 to 30 miles, as for example that crossing the County of Halifax in the longitude of Sheet Harbor. The local faults, confined chiefly to single folds or domes, are short and uncertain in their course. These are however more important to the prospector than the great faults because of their location within his sphere of work.

This faulting appears to have begun during the formation of the gold bearing veins and to have contin-

ued until after the close of the metamorphic action that resulted in the formation of the granite. As the age of a fault when known gives a clue to its probable effect on the gold bearing rocks, I shall refer to this phase of the subject later on.

Faults are styled either right or left hand faults, meaning that no matter which side of a fault you stand on the throw will be always to the right or left as the case may be. For example if you stand on the east side facing the fault with the flow of the rock on the opposite side to the right then a change of position to the west side of the fault will make no difference. The throw of the rock on the other side will still be to the right. Therefore the expressions right and left hand faults saves a lot of explanation. The great faults are seldom lines of great weakness or the molten granite would usually have found vent through them.

The following figures show the different forms of faulting frequently met with by a prospector in his work. They are not drawn to scale but give a true idea of their nature.

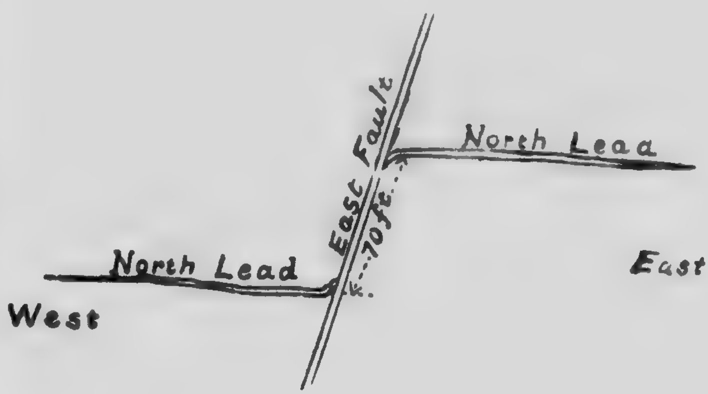


Fig 9. Surface Plan

Fig. 9. From Moose River Mines. A fault that caused a great deal of trouble in tracing the North Lead east after its first discovery. An instance where the pressure from the south has overcome that acting east and west.

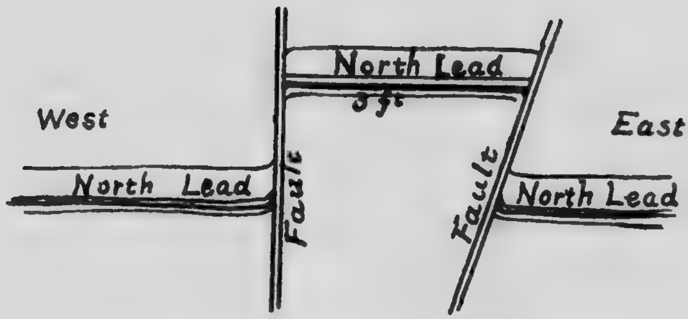


Fig. 10. Surface Plan

Fig. 10. From Moose River Mines. Section on the North Lead 70 or 80 feet deep. A gradual shrinking of the earth's crust has prevented expansion east and west, while compression from the south has pushed the central block back to the north.

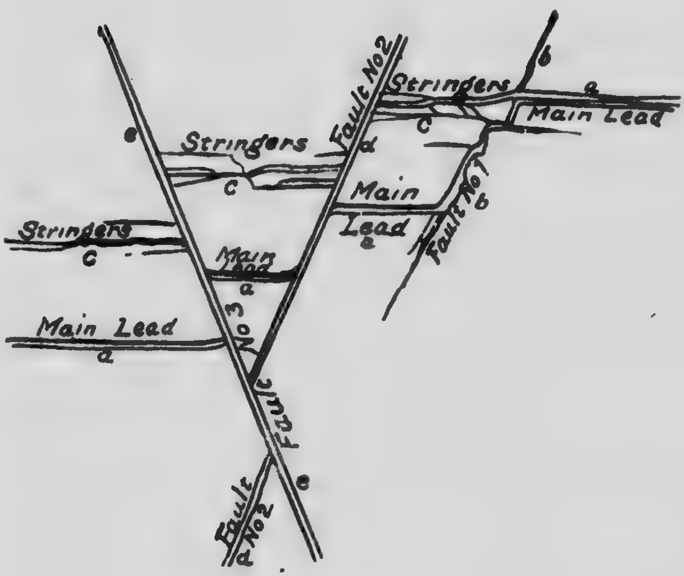


Fig. 11 Surface Plan

Fig. 11. From Moose River Mines. A most complicated fault showing action at five different periods —viz—

a, main lead formed.
b, main lead faulted at *b* by fault No. 1.
c, stringers (small leads) formed.
d, main lead and stringers faulted at *d*.
e, main lead, stringers, and Fault No. 2 all faulted by Fault No. 3.

They belong to Classes 1 and 6, or 7. All are left hand faults.

Fig 12. Vertical Section

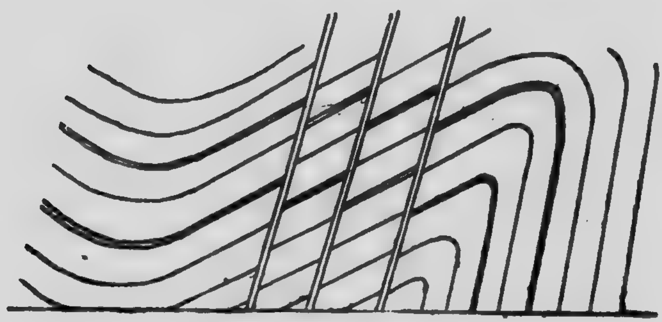


Fig. 12. From Sherbrooke, Guysboro Co. Faults showing the effects of pressure from two directions, a folding pressure from the sides and a faulting pressure from below.

Fig 13. Vertical Section

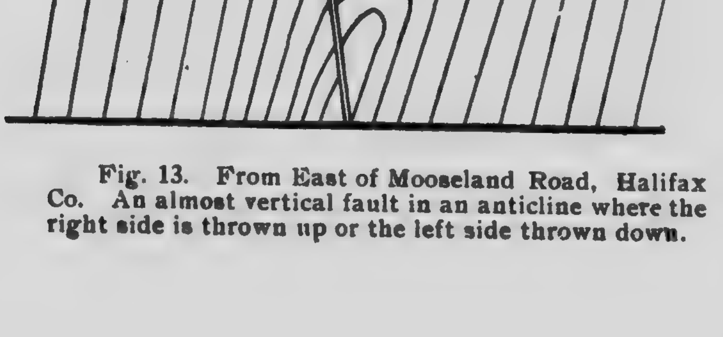


Fig. 13. From East of Mooseland Road, Halifax Co. An almost vertical fault in an anticline where the right side is thrown up or the left side thrown down.

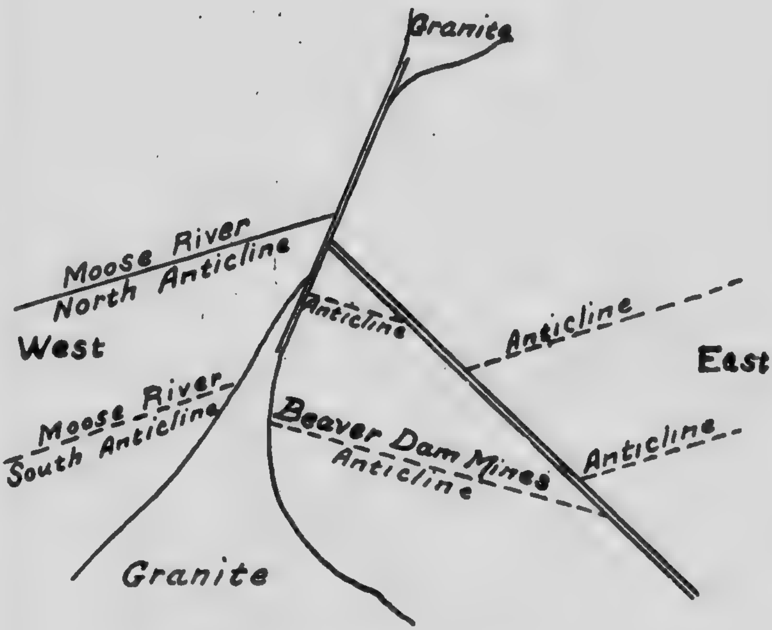


Fig 14. Surface Plan

Fig. 14. From Beaver Dam, Halifax Co. Complicated faults showing the influence of granite to the south and north. The district has been shortened and moved to the south and granite injected into the east fault. The rock to the north of the fault has also been shifted to the south and south east. The faults belong to Class 5. Much more exploration is needed in this neighborhood before a good idea of the nature of the changes the faulting has brought about can be had.

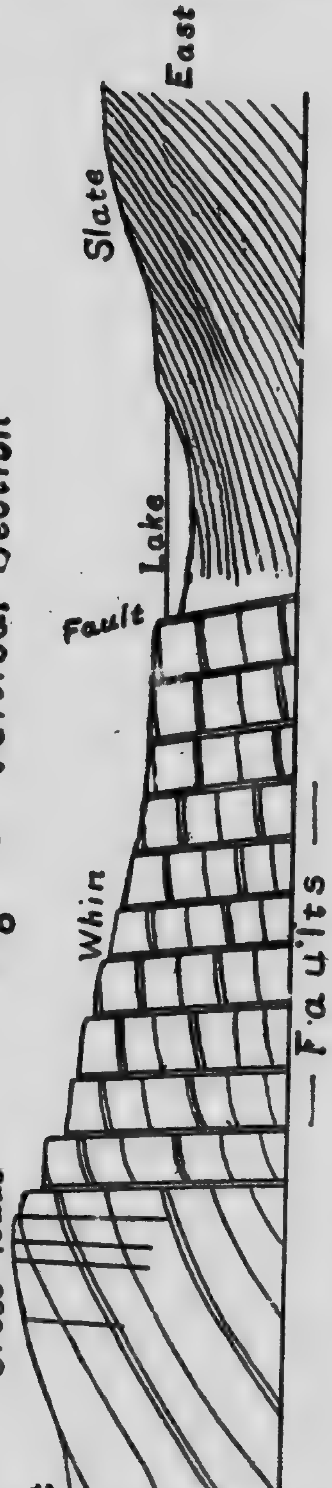


Fig 15. Vertical Section

Fig. 15 represents a series of faults about 1½ miles in width, with the down throw on the eastern side where the heaviest faulting has been done. Here the upper slate division abuts on the whin. The junction or line of contact is not seen as the basin formed by the fault is covered by a lake. Neither the cause nor the length of these faults I have been able to ascertain. However the faults themselves or leads corresponding with them in course or position have become mineralized and carry gold. Two of these cross leads on the hill to the west have been mined to a slight depth. In this series of faults, the slate, which belongs to a horizon probably 5000 feet or more above the whin, is now sunk to the same level.

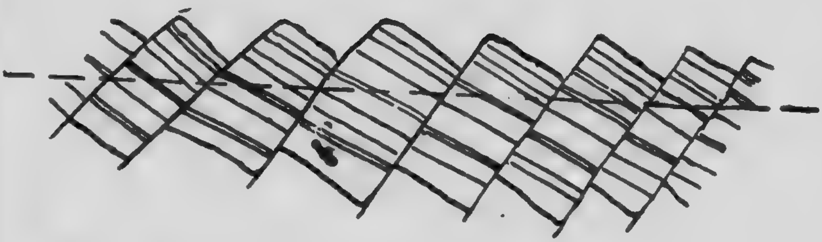


Fig 16. Vertical Section.

Fig. 16. Faulted rock before erosion.

Fig 17. Vertical Section.

Fig. 17. The same as Fig. 15 after erosion.

CHAPTER IX.

Cross Country Faults.

These faults interfere greatly with the continuation of the anticlines and are often a source of much trouble, so a knowledge of their direction, extent, and position is very necessary. I therefore give a list of the principal faults taken chiefly from the maps issued by the Geological Survey Dept. These maps include only the country from Chester east to Canso. List No 1 includes only the cross country faults, the most extensive but not the most important from a prospectors or miners point of view.

LIST No. 1

(a)—Fault through New Harbor and New Harbor River, Guysboro County. Course North west by north Left hand fault. Throw 1000 to 1800 ft. Pitch of anticlines east. Granite close by on the North-east side crossing North west end of fault without either disturbing the other. Runs out to sea, the north west end terminating in much disturbed country. 8 or 10 miles long.

(b)—Country Harbor fault. Divides apparently into two faults near the head of the Harbor. Course north-west by west. Length about 15 miles. Drop on east side at least 1500ft. Left hand fault. Throw from 5000 to 7000 ft and probably more. This is the most important fault or system of faults in the province. Anticlines have been broken and shifted until some portions of them have been turned at right angles to their usual course, for example that part forming Upper Country Harbor Gold District. This being a left hand fault with the rock on the eastern side thrown north it would appear that the gold at Upper Country Harbor was a portion of an anticline further south. Yet there is an opinion among some who have examined the ground that this fold is a portion of the Cochran. Hill anticline thrown south. Granite tracts approach the faults very closely on both sides and even cross them. The whole surrounding country is much faulted, position of folds are uncertain, and little information is available regarding courses and dips of the gold bearing rocks Until a more thorough exploration is made little more can be said.

(c)—Isaac's Harbor fault. Course North-north-west. Left hand fault. Length probably 7 or 8 miles. Throw 1800 to 2500 ft. Anticline pitches east.

(d)—Indian Harbor—St Mary's River fault. Course North-west by north. Length about 18 miles. Left hand fault. Throw at north end 250 to 700 ft: Throw

at Indian Harbor 4000 ft or more. This is the fault which is represented as cutting and shifting the granite and on which doubt has been thrown. A later and more thorough examination may decide the question. An important fault as it cuts the eastern part of the Wine Harbor gold district.

(e)—Sheet Harbor Road fault. Course North-west by north. Left hand fault. Length about 35 miles, starting at the Musquodoboit Valley and running out at Beaver Harbor, thence among the islands and out to sea. The throw varies, the greatest amount of displacement being along the Sheet Harbor—Musquodoboit road where it is 8000 to 10.000 ft. At Beaver Harbor it is from 4000 to 4300 ft, and on the south side of the Musquodoboit River the throw is about 1000 ft. Near Musquodoboit there appears to have been an up throw on the eastern side, while near Sheet Harbor there seems to have been a down throw on that side. This is evident from the lesser or greater width of the slate belts on the eastern side than on the western. The sinking of the slate belt would make it wider on the surface and vice versa. The Beaver Dam granite tract crosses this fault where the throw is greatest bu: apparently judging from surveys, does not affect it in any wav.

(f)—Mulgrave River—Twelve Mile Stream fault. Course North-northwest. Left hand fault for 14 miles Length 23 miles or longer the northwestern end being effaced by a fusion of the region into granite. Here it becomes a right hand fault. While a left hand fault the throw is from nothing to 2100 ft. There is also an upthrow on the east side which makes the slate belts on that side narrower than on the western side.

Where this fault changes to a right throw the displacement is about 6000 ft. gradually increasing going northwest until it is 10000 to 12000 ft near the head of the Musquodoboit River. This change is accompanied by a down throw on the eastern side.

The whin belts lie much flatter on the western side of the fault than on the eastern side, with the result that the Fifteen Mile Stream anticline which is 4¾ miles wide to the east of the fault increases to nearly 6¾ miles on the western side.

As the granite has effaced the north western end of this fault it is hard to tell how much of the movement in this region is due to the fault and how much to the granite. Much exploration is needed to clear up the problems presented here. This region, especially to the north has shown much to encourage prospectors.

(g)—Mooseland fault. Course north-west by north. Left hand fault. Length about 13 miles. Throw at south-east end about 2300 feet gradually lessening pro-

ceeding north-west until the fault ends south of Caribou Mines. The only serious displacements so far known are at the Mooseland mines, where the prospector's search is somewhat complicated by the presence of several faults across the anticline near the granite. This fault is worth investigating because of its cutting a district of much promise but slightly developed.

(h)—Ship Harbor fault. Course north-north-west. A left hand fault. Length about 10 miles. Begins near the granite at the head of Ship Harbor where the throw is very small. Going south this throw increases until among the islands off the mouth of the harbor it is about 6000 feet.

(i)—Porter's Lake fault. Course north by west from the sea to the head of the Lake, thence north-east to Dollar Lake. A left hand fault with an upthrow on the eastern side near the granite. Total length about 22 miles. Throw at the north end near the granite about 1800 feet, gradually diminishing as it approaches the sea. This fault like that of Ship Harbor passes through or near no gold districts though a number of leads are known near the eastern side of the fault.

(k.)—Halifax Harbor. There are indications of a fault running through Halifax Harbor and north into Hants County, a distance of about 35 miles.

(l)—Newdy Quoddy fault. Course north-west by north. A left hand fault, as are all the others. Length doubtful, probably 10 miles. Throw 2000 to 4500 feet. Runs out to sea. Going inland the throw decreases.

(m)—Oldham to Soldier Lake, 8 or ten miles. Course north-east. Details wanting.

CHAPTER X.

List 2.

Local Faults and Fault Classification.

Location of fault	Course	Right or left hand fault	Amt. of throw	Particulars
Cochran Hill	NE	L	40 ft.	On area 508 to 590 Block 76
Upper Seal Harbor......	N by W	L	500 ft. or more	On Davidson Brook.
Pease Brk., Guysboro Co	NNE	L	2300 ft	Evidently caused by Granite.
Forest Hill "	?	L	?	" " " West end.
Upper Country Harbor	?	L	?	" " "
Harrigan Cove	N by E	L	1500 ft	On Eel Brook several miles long.
Wine Harbor	NW	R	25 "	Area 30, Blk. 41, to Area 24, Blk B. 30 ft. upthrow on W side
Salmon River	NNE	L	50 (?) "	Areas 70 to 317, Block 3.
Isaac's Harbor, East.........	NE by E	L	100 to 250 "	Dun Cove Brk., Area 178, Blk. 1 to 808 Blk. 2.
Oldham	NNW	L	160 "	Baker Lead, Areas 532 to 1597.
Mooseland	N 70 W	L	?	Downthrow on E side. Caused by Granite.
" 2nd	N 35 W	L	Total 560 "	Areas 482, 484, 518, 519. Blk. A. Caused by Granite.
S. E. side Scraggy Lake	NNW	L	1500 (?) "	About 4 miles long. Runs S. towards Granite.
Head of Grassy Lake	NNW	L	1400 "	North Mooseland. Part of the Main Fault.
Harrigan Cove............	N by W	L	100 "	Area 319, Block 2.
" " "	NNW	L	50 "	Area 278, Block 2
Lawrencetown......	NW by N	R	50 to 100 "	Area 103 to 722, Block 1.
" " "	NNW	R&L	30 to 100 "	" 24 to 671 " S end to R N end thrown to L.
" " "	NNW	R	10 to 30 "	" 217 to 481 "
Wine Harbor	N	L	125 "	Area 9, Blk. F to Area 24, Blk. A, upthrow 30 ft. on W side.
Fifteen Mile Stream.....	N?	L	150 to 170 "	" 714 to 886, Blk. (?) to S E upthrown on E side.

Local Faults and Fault Classification—Continued.

Location of Fault	Course	Right or left hand fault	Amt. of throw	Further Particulars
Fifteen Mile Stream	N	R	100 ? ft	Area 914 S E Blk. to 86 N E Blk.
Leipsigate Lumber Co	N by W	R	400 ? "	On fissure W of Micmac Mine.
Aspotogan "	N by W	L	1300 "	Probably caused by Granite.
Hd of Musquodoboit Hr.	NW	L	600 "	Runs into the Granite. Caused probably by shrinkage.
Musquodoboit Hr	NNW	R	1400 "	Power's Cove, West Side. Probably 4 miles long.
Killag River	NW	R&L	L 400 to R 2500	From Beaver Dam to Killag. Probably 7 or 8 m. long.
Beaver Dam	NE	R	2500 "	From East of Beaver Dam to Little Como Lake. 3 miles long.
Caribou Mines	NNW	R	0 to 65 "	Area 328 to 822, Block 2. Only on South side of fold.
Crows Nest	WNW	R	150	Area 973 to 815? Block 75. 1500 E of Indian Harbor fault (L).
3 m E of Meagher's Grant	N	R	600 "	Granite not far south. Probable cause was Granite.
Sheet Harbor	NNE	L	2500 ? "	In harbor entrance. Several miles long.
Dollar Lake	N by W	R	350 ? "	On West side of Lake. Waverley anticline.
Waverly Mines	N by W	R	100 to 330 "	433 N through Muddy Pond. Granite 2 miles east.
" "	N by E	R	220 "	Area 434 N by E through W side of Lake Thomas.
" "	N by W	R	380 "	Through Lakes William and Thomas.
S E of Goffs 2½ miles	N by W	L	700 "	From E of Road to Beckwith Lake. Shifts Waverly anticline
Gold River 4 faults	N by E	[illegible] L	?	One in Lincoln Mine. One at Branch 2. West of River
Tangier 4 faults	NNW	R	30, 45, 50, 80	Areas, 246,247, 272, 273, 274, 319. Block 4, Mooseland Road.
Tangier	NW by N	R	60	From foot of Mill Lake down Mill Brk.

Tangier, 7 faults	NNW	L	8, 12, 20, 30 40, 115, 150,	From Mill Brk. to N side of Rush Lake.
Tangier....	N	R	12 to 50	NE side of Copper Lake.
Moose River	N by E to NNE	L	4 to 165	Irregularly disturbed 10 faults.

Moose River, Tangier and Lake Catcha are noted for their broken up condition, the latter especially having at least 18 or 20 faults, making prospecting a most difficult job. All are right hand faults, except where a triangular block has been forced outward between areas 206 and 214, Block 2. A heavy stress seems to have been brought to bear on the west end of the district forcing it northward. Several very extensive flat faults are seen here, the western end of the anticline having been pushed north beneath the upper layers up to 350 ft. The faults run various courses.

Salmon River	N?	L	1500 ?	Through Lake Eagle.
Mt. Uniacke 2......	N 51 W	L	200	East end of district.
	N 27 W	L	40	
"	N	R	80	Near School. West end.
"	N	L	1085	Through Coxcomb Lake. Length unknown.
Montague	N	L	40	Area 1748 to 954 at saddle. At least 1400 ft. long.
"	N	L	25	" 1571 to 828 " " " 1200 "
"	E by N		40	" 1331 to 828 " " 6450 ft. older than others.

All faults, even in one district, are not usually of the same nature, nor have they been formed at the same time nor by the same cause.

When one lead faults another, as does the Baker lead at Oldham, it is as much a fault as is the barren clay filled faults that disturb a district. So the gold bearing fissure vein when it cuts and displaces main leads is also a fault. Faults therefore belong to several classes, the differences between which we shall examine.

Class 1. Usually small, irregular, and contemporary with main leads carrying gold. The broken ends of the main leads are usually united by ore in the fault itself. Examples are numerous, Fig 11, Fault No 1, from Moose River mines show a fault of this kind complicated by later breaks.

Class 2. These faults often cut off completely all leads they cross, sometimes displacing them. Their mineral contents however often include gold. They form the fissure veins occasionally found in Nova Scotia gold districts. Though formed after the anticlines had assumed their present shape the formation was still within the era of gold deposition in this province. It may be said that there is no particular era of gold deposition, but it is well known that almost every mining region has its own special era, in which one or more ores were precipitated. These fissures dip as a rule toward the centre of the anticline. A good example of this class is seen in the Baker vein at Oldham which displaces even the anticline. The Libbey vein at Brookfield and the Prest lead at Blockhouse probably belong to this class, See Figs 5 and 39.

Class 3. Usually shorter then the last, often only reaching from one belt to another, they are sometimes of great width, well defined and mineralized, though seldom or never gold bearing even where crossing gold bearing main leads. They are styled bull leads or cross leads by miners. Their age is doubtful, though certainly later than the completion of the anticlines and the period of gold precipitation in the older leads and faults.

Class 4. Faults of this kind though common the world over are features of a puzzling nature. They are of great length and depth, reaching down without doubt to the bottom of the gold series and the supposed source of heated mineral waters, yet they are not the seat of great veins and ore bodies. They represent on a small scale the great fault in the Rocky Mts. where there has been an upthrow on the east side of about 10,000 feet, which, though deepseated and well defined as it is, has not developed into a great and rich ore deposit. These main faults were no doubt formed after the completion of the folding when the rocks had

become rigid. This is evident as neither local twists cross synclines nor local faults have as far as is known affected their regularity. Their great length and parallel courses lead to the belief that some evenly distributed, persistent, and tremendous force to the south or south-east has acted as the motive power in this faulting—viz.—a strain developed by the shrinkage caused by the cooling of the earth's crust. When the folds could be squeezed no closer they were broken and portions were shoved back where the pressure was less. As to their age, if we except the doubtful Indian Harbor Lake fault, (see previously), it was before the formation of the granite. Decisive evidence is seen where the Sheet Harbor Musquodoboit Road fault crosses the Beaver Dam granite tract. This small tract of granite is not cut nor faulted, neither does the fault show itself as a line of weakness along and into which the granite has been injected. The only theory that accords with all facts is that ages after the movement of the rocks had ceased and the sides of the fault had become firmly united, the rock on both sides had been gradually fused into a molten mass.

Faults of this kind run through the gold districts of Isaac's Harbor, Upper Country Harbor, Mooseland, Cochran Hill and other places.

Class 5. To the fifth class belong the smaller faults by which gold districts near granite tracts have been broken and drawn toward the once molten rock. A good example of a fault of this class is seen at Mooseland, where a fault caused by the shrinkage of the cooling granite is seen on the 96 foot level of the Stemshorn Mine. Here the anticline has been faulted and drawn southward toward the granite, and into the vacancy left has fallen the eastern wall of the fault. The result has been the opposing of a higher bed on the eastern side to a lower one on the western side. The course of the fault is north 70 degrees west, which is almost parallel to the boundary of the granite a short distance south. Fig. 43 will show the nature of the fault and the value of a little knowledge of structural geology on the part of a prospector who attacks problems like these.

Another good example of the faulting power of shrinking masses of cooling rock is seen at Beaver Dam, where a large section of the anticline is broken by two cross faults and drawn south toward a granite tract. That these faults had been formed or reformed by the granite, at about the same time is shown by the injection of the molten rock along their courses. This proves either that an old line of weakness had been re-opened, or that the fault has been formed when the granite was still molten and before it had cooled to such an extent as to prevent injection into newly form-

ed faults. So far the evidence gives support to the opinion that the formation and filling of the fault was contemporary. This would of course be an exception to the general rule because the strain would become tense enough to cause faulting only after cooling had proceeded far enough to cause shrinkage. In this case the molten mass would have ceased to be fluid enough to flow. See Fig. 43. The most striking example of disturbance by granitic shrinkage or flow are the dislocations and movements of anticlines seen at Upper Country Harbor and Forest Hill. These disturbances are on a very large scale and complicate exceedingly the work of the prospector. On these districts see previous remarks.

Class 6. The sixth class of faults have so far been proved to exist only in the granite. They are attracting more attention than formerly because of the fact that they contain valuable ores. Such faults in the granite of New Ross Lunenburg are the seats of two or three large deposits of manganese, now being tested. Drift from other veins of the same kind indicate future work for the prospector in that region. See previous chapters for more details on this subject. Other mineral bearing faults contain silver bearing galena, one of which, the Dunbrack silver mine north of Musquodoboit Harbor show the possibilities of this class of fissures. Discoveries of silver bearing galena in the drift near or on the various granite tracts indicate the existence of other probably valuable deposits. For further details see my previous references.

A fault referred to before the one apparently cutting the granite tract northwest of Indian Harbor Lake, may belong to Class 4. But, as the correctness of the survey of that particular locality is open to doubt, it will be well to suspend opinion until further exploration affords more evidence.

However, enough has been discovered in the granite to confirm the wisdom of paying attention to discoveries of drift ore in granite regions, following up the clues to better indications and perhaps valuable discoveries.

Class 7. Faults cutting other faults and displacing them may belong to any recent period. These, so far as we know are barren of ore; their chief importance being in the trouble they cause the prospector by cutting off the leads he is following.

They are often filled with hulk, the ground up fragments of rock crushed in the forming of the fault. A good example is seen in Leipsigate District northwest of the old Pelton Mill where a wide belt of crushed clay material cuts several leads.

It is maintained by Mr. Wright of the Dominion Geol. Survey, from evidence seen principally in Lunenburg County, that there were two periods of granitic (or

eruptive) action, the last fissuring the older granite and forming the mineral bearing veins of New Ross. This later rock also pierced the older granite in the form of dikes. These evidences should of course extend to the whin and slate to make the suggestion positive.

A study of the lists of faults already outlined show that the great majority are left hand faults, that is, they are nearly all thrown north on the east side as in Lunenburg and Queens counties. The cross country faults, 13 in number, are all left hand faults with one doubtful exception, the Twelve Mile Stream fault, of which only the northern end is a right hand dislocation. This portion shows evidence of being disturbed by the granite. The same force seems to have acted in the same way from Queens county to Canso in forming the great faults as well as some of the smaller ones.

Out of 73 local faults only 22 are right hand and only 24 run east of north. 13 of these local faults seem to have been formed or influenced by the shrinkage of the cooling granite.

There are doubtless many more of these local faults which cut and shift leads in the gold districts, a knowledge of which would greatly benefit our prospectors. The heavy covering of drift no doubt hides many more than the number known.

This system of faults extends west and the parallel courses of the rivers of Queens and Lunenburg counties indicate the presence of faults.

CHAPTER XI.

Surface Geology.

It is generally known by miners and prospectors that the northern part of America, Nova Scotia included, was in times long past covered by a thick mantle of ice. The evidence for such belief is the same as now accompany the moving of the vast ice masses that cover Greenland and the Antarctic regions. The great piles of earth and stones now being pushed outward toward the sea are the same as the great hills of drift that cover Nova Scotia. The furrows and scratches that are now being made by the grinding earth and stones beneath the ice in Greenland and some other mountainous regions are the same as we see on the polished bed rock in this province. The huge boulders weighing hundreds of tons now being pushed along by the ice-fields of Polar regions are represented by the great boulders which litter every part of Nova Scotia, and which are often known to be miles from their starting points.

The long and regular ridges of sand and gravel known as whalebacks and seen in different parts of the province represent the crevasses still seen in the glaciers of Greenland and other countries. Into these fell or flowed all the material torn from projecting spurs of rock or loose earth over which the ice sheet plowed its way. They were not watercourses seeking the lowest level for they are often found crossing the course of the drainage.

This time of extreme cold is known as the "Glacial Age" and the deposits it has left as till or boulder clay. The furrows and scratches the ice has left are known as striae.

This sheet of ice once covered all Canada and reached far into the ocean. Like a huge sheet of dough it pressed outward by its own weight, carrying southward over the province earth and rocks from the north. Then it gradually diminished and became thinner, and and slowly broke up into separate sheets, one of which covered Nova Scotia. This after moving outwards in all directions, advancing and retreating in varying changes of climate, dwindled and separated into hundreds of patches of ice. Then began a period of dissolution when rivers of water from the melting ice removed and redeposited the debris ground from the rocks by the first gigantic ice-field. At the same time the remnants of this ice-field moving down the nearest slope or river valley re-scored the already furrowed rocks,

perhaps in other directions. Then the remaining fragments sliding into the nearest hollow, melted, and put an end to the "Glacial Age."

All this complicated considerably the arrangament of the beds of material left. Then the rivers and brooks began deepening their channels, cutting away and laying down again the older beds of clay sand and gravel. This action has lowered lakes, filled valleys, and re-arranged and shifted former beds to all points of the compass. These processes have complicated matters to such an extent that it forces the Nova Scotian prospector to be a specialist in local glacial geology. He must bend his energies to the solving of riddles that never enter the head of the miner, and that few college trained engineers are capable of solving correctly.

The boulder clay is a doughy or solidly packed mass of blue or grey clay mixed with rocks of all kinds worn and angular. This has been torn from the bed rock, part of it ground to a pasty mass, and the whole carried in a southerly direction by the expansion and movement of the vast ice fields behind it.

With this was often carried pieces of quartz broken from the rich leads in our gold districts. When this was continuous for any length of time it left a train of gold bearing boulders which have often been traced backwards to the leads from which they came.

Here prospecting would be a simple process were we dealing with the deposits as they were first laid down. But where old streams crossed the line of drift or former lakes covered the land the drift would be shifted and the prospector's job made much more difficult.

The greater part of the drift in the Eastern Counties is unmodified boulder clay, while in the Western Counties there has been much modification since the Glacial Age. The confusion caused in the West by the beds of sand, clay, gravel and boulders brought from different places to one spot is not present to such an extent in the East. The course travelled by the drift in Halifax and Guysboro Counties varies little from south, while in Lunenburg and Queens Counties it always travels east of south, but with wide variations in course. In Yarmouth and Digby Counties the course except locally is generally outward toward the sea.

There are many signs which the prospector should be able to read at once and thus save both time and money. He should be able to tell which of the many workings on the bed rock indicate the course his rich boulders have travelled. He should be able to track these boulders to their source, much like following the tracks of a fox to its den by following its footsteps in

the snow. He should be able to recognize quartz from a lead he has seen before. He should also know after a little work whether he has one, two, or half a dozen different beds of clay sand or gravel to dig through, for each may have come from a different source and on a different course. Much of this can only be accomplished through experience, and no college course or course of reading can do much more than give a prospector a foundation on which to pursue his more practical studies in the field.

The markings on nearly every smooth rock surface show the direction taken by the ice with its accompanying burden of drift and gold bearing quartz. These markings, often three sets, as at the Fifteen Mile Brook, run in different directions, and the closest attention should be paid to them in order to decide which of them marks the course in which the ice drift has travelled.

These markings, or stria as they are called as a rule, are easy to distinguish apart though not always so, especially when all run the same course. The deepest furrows, usually from 6 inches to 5 feet wide, generally run due south in the Eastern Counties and east of south in Lunenburg and Queens. They show the course of the continental or of the provincial ice sheet at its greatest extent, and are usually found on the high lands and in the interior. Smaller furrows and scratches, generally parallel with river valleys and down the face of a sloping country, denote the course of the ice after breaking up into separate sheets, say 10 to 30 miles in length. Small scratches often scarcely visible show the course of the last remaining patches of ice down each little valley, brook and lake. These run in any direction according to the slope of the land, and are very apt to lead the prospector astray unless he has a little experience. Land slides also leave their markings but their courses are always down step inclines.

In each bed of transported material there is a meaning and a history that appeals to the prospector more than to any man. It is a book of nature which only reason and experience can enable us to read.

A firmly packed mass of blue or grey clay with a great variety of rocks means boulder clay brought there by an immense mass of ice. Some of these boulders are round, meaning that they have been subject to much wear probably in water, or have come a long distance or are made of softer material than others. Some of the much worn rocks may have belonged to a more ancient conglomerate, or glacial deposits, and were rooted out by the nose of the advancing ice mass. Others are angular and sharp edged, proving that they came from a nearer source or have been more

recently broken from the parent rock. If the deposit contains more granite boulders than other kinds its last passage was over or near some granite tract. If the whin or slate boulders are in the majority the route of the ice sheet was probably over a wide belt of whin or slate. Anyway, as a rule the more sharp edged the rock fragments are, the nearer the source from which they came, rocks from kames and conglomerates excepted.

Many rounded waterworn rocks and pebbles unequally distributed with the finer material washed out means a former stream with a rapid current.

Boulders with fine and coarse sand in irregular beds and a slight inclination of surface means a stream with a moderate current or a shallow lake shore of small extent.

Circular or oval well worn flattish stones of moderate size indicate a lake shore where the winds have had considerable strength.

Banks of sands of considerable extent, but unevenly distributed, mean the sides of a large stream with a moderate current or the mouth of a smaller stream with a stronger current.

A fine grey or purplish-grey clay is a deposit in still water from a stream with a fairly strong current having its sources in a hilly land where it cut away banks of boulders clay. The current assorted the material, carrying the finest of it the longest distance. Sharp edged rocks or quartz in this deposit mean that the rock was carried there by floating ice, often from any direction but usually down stream.

A bed of black material with sticks, buds, leaves and insects &c., means a shallow pond or swamp with higher land around. If this is found between two beds of boulder clay, it means that the ice had retired to the north, probably for hundreds of miles, and that a fairly temperate climate had existed for a long time, after which the Arctic weather returned and a new ice sheet covered the province.

A bed of red earth or rusty boulders means that the bed had been exposed to the air, the thickness of the rusted layer being a measure of the time passed before it was covered with a new deposit. Thus the thickness of the rusted earth on the present surface is a measure of the time past since the last advance of the northern ice sheet, or the last phase of the "Glacial Age." So the thickness of the rusted beds beneath it indicates the length of the warm periods between former advaces of the nothern ice. According to this method of measuring, which cannot be very incorrect, the rusted conglomerate in the LaHave valley at Bridgewater, or the rusted layers in the gravel pits at Rhodenizers Lake to the east of the LaHave, indicate

a much longer period than has elapsed since the ice sheets last disappeared.

As an example of the complications of drift, I may give my experience at Blockhouse, recorded in the Journal of the N. S. Institute of Science 1896 under title of ' Glacial Succession in Lunenburg County.' This was made up from a record kept on the ground as the work proceeded. The corresponding layers in each shaft are numbered alike in plan, and notes, regardless of their distances from the top or bottom. As the pits were sunk close together the indentification of the various beds was not a very difficult matter. The absence or presence of gold in an upper or lower bed was only owing to the fact that further north or northwest that bed touched the lead. The glacial markings on the higher lands around showing that the main ice sheet travelled south 45 degrees east, (S 45°E) but the lower boulder clay at Blockhouse Mine, owing probably to its confinement in a shallow basin, moved S 22° E. This bed of drift however showing no gold where our prospecting pits were opened. The gold bearing drift judging by the material it contained was nearly all local and was transported about S 50° to 55° E. Its course was probably guided chiefly by the slope of the surface.

Referring to Figs 17 & 18, the first shows three prospecting pits sunk on a south-east line from the lead. The next plan shows three pits sunk on the lead beginning where the first line ends and running north. The pits are numbered from north to south.

As noted in the article mentioned, the lowest bed here is No 2, No 1 being the underlying Bridgewater conglomerate not present here. No 2 is a tough bluish clay, white with fragments from the underlying slate and whin, purely local and pre-glacial, or at least previous to the last return of the continental ice sheet. It contained no gold except a few small fragments in pit No. 2 where it overlaid the lead.

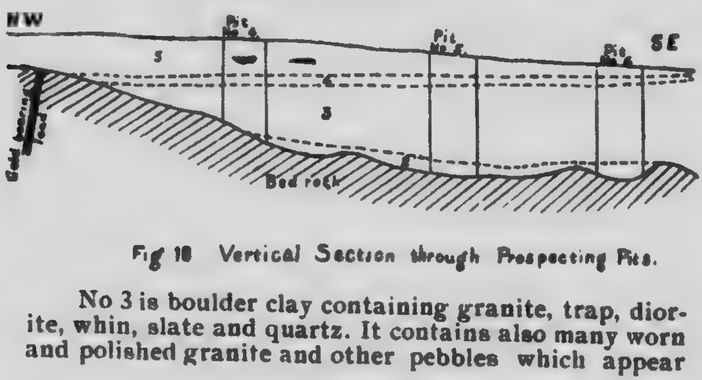


Fig 18 Vertical Section through Prospecting Pits.

No 3 is boulder clay containing granite, trap, diorite, whin, slate and quartz. It contains also many worn and polished granite and other pebbles which appear

to have been washed out of an earlier deposit. It contained no gold except a few fragments where it overlaid the lead in pit No 3. Bed No 4 consists of broken slate cemented with bog iron, white and yellow clay and fine sand, probably the results of deposition by floating ice and still or almost still water with current only during freshets. It was probably somewhat worn down by the freshets that proceded the last advance of the ice sheet. Bed No 5 consisted of brown, loose, rusty, local slate gravel and soil, with gold bearing quartz partly cemented in places. It passed over the rich lead for which I was searching and carried with it large quantities of the ore from that vein. Bed No 6 consisted of fine clay, evidently having settled at the bottom of a shallow pond. Bed No 7 was local, consisting of broken slate and soil probably moved by floating ice as the underlying clay bed showed no sign of disturbance. There was however a possibility of the last layer having been moved by a glacier when the clay beneath was frozen. This fact has been noted by travellers in the northern regions.

Often one bed gradually passes into another of a totally different compositiom without any sudden break, thus showing a continuous deposition of material though under different conditions.

In some cases the beds follow each other in a way that shows plainly not only different conditions but also that a long interval of time had elapsed between the deposition of the lower and the upper one, as in Fig 19 below beds 5 and 10.

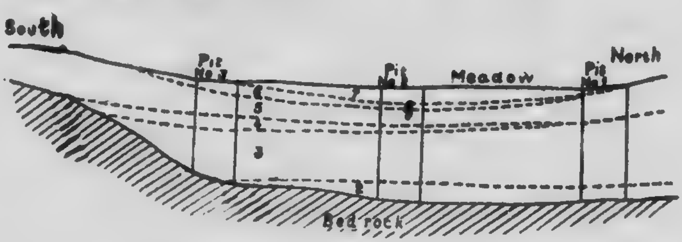


Fig 19 Vertical Section along Lead.

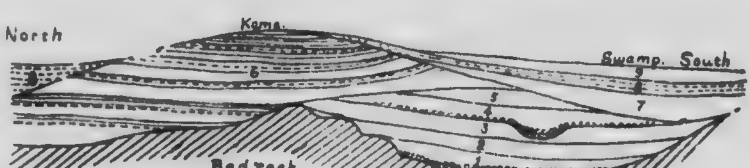


Fig 20. Section of Drift.

Showing unconformability or a difference of time in the deposition of 3 different sets of beds.

Nos. 1 to 3 older Preglacial Conglomerate.

Nos. 4 to 5, are the beds of a later pre-glacial conglomerate.

No. 6 is a well stratified kame, still pre-glacial or interglacial.

No. 7 is a boulder clay of a later age, often called till or dritt.

No. 8 is modified boulder clay, sand gravel and clay in layers of same age as No. 7.

Nos. 1 to 5, represents deposition by swiftly flowing water or wave action, with an interval of excavation between 3 and 4.

The beds were worn off and redeposited in a slightly different position in the next set of beds, No. 6. The material in these beds are finer and more distinctly stratified. These kames, as they are called, are usually rusted through a great part of their depth showing a long exposure to the weather.

No. 7 represents the last invasion of the ice sheet and is a crude mass of boulders and clay deposited after long erosion of the kame.

No. 8, formed by the action of water on both kame and boulder clay, is made up of layers of gravel, sand and clay, the latter chiefly near the top. Still more quiet conditions, are shown in the deposition of swamp muck No. 9.

CHAPTER XII.

Exactness in Observing and Recording.

Too much emphasis cannot be placed on the value of exactness and detail in a pursuit, some parts of which is like groping in the dark. Exactness in observation should only be equalled by exactness in recording, and finally by exactness in comparing facts however unimportant, as they may develop into importance when you want them most and have'nt got them. The greatest prizes are often missed through want of attention to some small detail.

Plans and note books should be in constant use and everything, should be recorded in black and white. It is surprising how much more they will remember than the ordinary mind. I have heard men of very ordinary intelligence, say that they could remember all that was worth remembering. Such genius should be caught and preserved in alcohol as a wonder to coming generations. Some of my 30 year old note books have furnished me with important but long forgotten facts.

Note books should be of a proper size for the pocket, say 4 by 6 inches. The owner should practice fine writing as much more information can be put in the same space. Too many note books become troublesome to carry around and they soon multiply when one writes in a large hand. Never use a soft pencil or your writing will soon become a blur. A number 2 Faber or a 3 H, is soft enough well sharpened. A harder one is still better for fine writing. Each note book should be numbered in rotation in large figures on its cover. On its first page should be a complete index. All districts noted should have a special index in a small vest pocket memo book, referring to all notes in all your books on that particular district. Thus complete information as to the whereabouts of all notes can be had in a few moments, for time is just as important to the prospector as to any other man.

Next to note books and almost equally important are plans. On plans all shafts, pits, and trenches should be marked and numbered whether old or new work and the note books, referring to such work should have corresponding numbers. These should be arranged in rotation for each district.

The closest observations in getting details for plans is very necessary. A mere sketch map will not do as the amount of money involved, is often too much to be risked through careless work of any kind. A fairly good compass should be made use of in running lines for plans.

Even in so much detail there can be perfect order. With your note books well indexed and number and dated on the cover, with rough but exact plans to refer to, you can bring the experience of 20 years to hand in a few moments.

Order is the watchword that saves much time and money.

Words and phrases much in use should be condensed to save time and space. For example. foot= ft.′ or inch=in″., yard=yd., mile=mi., degree=°, right angle=∟, vertical= |, equal to =, inclination (of rock) =<, dip=dp, from=fm, about=abt., average=av., course or bearing=bg. length=ln., width=wd., depth =dt., height=ht., slate=sl., whin=wh., clay=cl., sand=sd., boulder clay=till, lead=ld., bedrock=bdrk., expenses=exp., reeeipts=rct., magnetic=mag., east= E, west=W, north=N, South=S, shaft=sht., tunnel =tnl., trench=tr., river=riv., brook=brk., stillwater =stw., lake=lk., and any other words that it would be convenient to condense.

A lead 8 inches wide, running 10 degrees south of west, dipping 10 degrees west of north, and inclining almost vertical or 80 degrees can be described thus,— ld. 8″ dp. N 10° W < 80°, a great saving as you see of time and space. If the enclosing rock is whin with a working belt of 3 ft., 10 inches of slate it can be entered thus,—wh. walls, sl. belt 3′ 10″ wd. In giving the dip of the lead you also have the dip of the belts. As the direction of the lead (if a bedded lead), is always at right angles to the dip a moments thought will show that a dip of N 10 degrees W. will mean a strike or course of W 10 degrees S, for the lead or belt. The course of a lead, known as its strike, is condensed to stk.

The old terms N W, W S W, or E by S &c., are too general to be used in prospecting. N and S with number of degrees E or W are more exact and easier understood, as N 45°E, N 89°E, S 1°W, S 80°E. "I guess," "In my opinion," "something like that," and all such uncertain phrases are out of date. We want facts wherever we can get them.

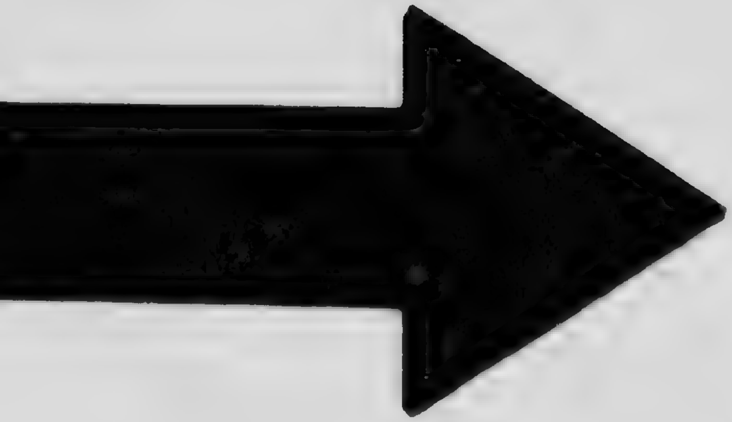
The condensed names of minerals that were or may be found in the Nova Scotian gold fields, will be found useful at times. These condensed names are called symbols and are usually taken from the Latin names of the minerals.

Aluminium.......Al	Gold ....Au	Silver..... ....Ag
Arsenic... ....As	Iron... ... .Fe	Sulphur..............S
Antimony........ Sb	Lead .... Pb	Silicon ....Si
Bismuth............Bi	Manganese.. ... Mn	Sodium.... ...... Na
Calcium.. ....Ca	Magnesium......Mg	Tin .... Sn
Copper........ ...Cu	Molybdenum... Mo	Titanium .... Ti
Cobalt..... .... Co	Nickel ....Ni	Tungsten .. .... W
Chromium. ......Cr	Oxygen . .....O	Zinc.... ....Zn
Carbon.... C	Potassium ....K	Platinum .... Pt

With the exception of gold, and possibly bismuth, platinum and silver all these minerals will be found as ores or combination of ores but the symbols will represent them.

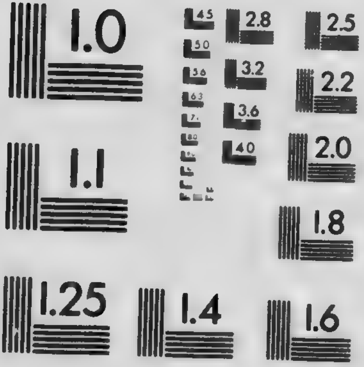
Results of work may be condensed as in the following table.

[redacted]



MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



Job	No (Number)	Ln (Length)	Wd (Width)	Dt (Depth)	Cu ′ (Cubic feet)	Hrs (Hours work)	Men	Cost (at 15 cts., per hour)	Cost per Cu ′	Cost per 1 in. ln or dt	Wet, medium or dry, very wet or very dry	Condition of soil
Pt	1	7′	4′	14′	392′	84	3	$12.60	cts. 3.2	$ .90	Wet	Boulder Clay (Till).
Tnl	2	16′	3′	5′	240′	128	3	19.20	8.	1.20	Dry	Cl & Sd (Clay & Sand)
Tr	3	42′	3′	4′6″	567′	52	2	7.80	1.4	.18½	At ft. of dry sft.	Rky (Rocky)
Pt	4	6′	4′	6′	144′	16	1	2.40	1.7	.40	Dry	Sd & Cl (Sand & Clay).
Pt	5	6′	4′	10′	240	93	3	13.95	5.8	1.39½	Very dry	Till (Boulder Clay).
Totals					1579	373		$55.95				

The foregoing are common prices, varying usually when the weather is wet or dry. Tables like these will save space and time and can be used for various purposes, such as—cost of supplies per man or per week or day, cause of lost time, days and hours per man, lists of tools, etc. In the above table is condensed several pages from a note book including extracts from time tables.

Exact measurements are very necessary, especially between leads or where the ground is much cut up among owners, or near the curved beds on the saddle of an anticline. It is always very difficult to get the exact curve of a lead or belt on the middle of an anticline and to transfer this to a plan, hence the exactness needed in measurements and also courses.

Dips may be measured with an instrument, home-made or otherwise, known as a goniometer. To make one get a thin piece of board or tin about 2 ft. long and 4 or 5 inches wide. One foot from the end and close to one edge, drive a small nail and leave the head projecting far enough to hold a metal pointer loosely, so that it will swing easily. Have the pointer short enough to swing inside the lower edge of the board. Within reach of this pointer inscribe a half circle and divide it into 180 degrees; the half circle reaching no closer to the upper edge than the pivot on which the pointer swings, as in fig 21.

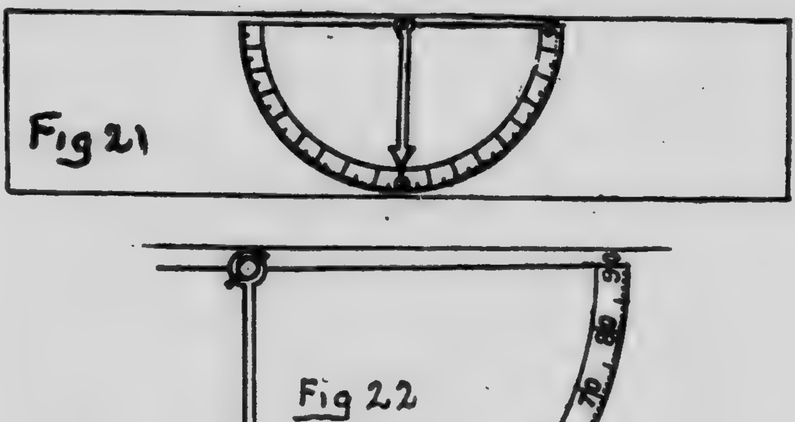


Fig 21

Fig 22

Each side of the circle should be marked and numbered as in Fig 22, which is an enlarged view of a part of Fig 21.

In taking the dip measurements the lower edge of the board is laid on the slanting rock surface and the point of the needle or pointer swings to the figures indicating the dip or inclination. In taking dips an error of 1 or 2 degrees may be allowable in prospecting. In taking a dip where only a small portion of the rock is visible, set down the inclination a little steeper than it appears to be because the exposed part of the rock is usually worn a little flatter than the part beneath the soil. Experience will teach how much allowance should be made for this wear.

Compass bearings should be taken to within ½ a degree as the course and tracing of a lead or a line is often very important.

In surface work every change in the appearance of the ground should be noted. For example, a thin seam of clay or sand is struck, different from anything below or above it. Below it, is gold, or gold bearing quartz, above it none. It therefore marks the boundary between the good and barren ground, and if it can be traced to other pits and trenches it will prove a valuable guide. Being however a low or level land deposit formed by water it will not be found in high ground. Every tub of muck should be examined for drift quartz. Every new layer of earth dug through should be examined and its make up noted so that it can be recognized elsewhere. Whether it contains much granite, whin or slate or quartz, or whether it is waterworn or freshly broken, each condition tells its own story, tells of a different source or a different mode of formation. Therefore its thickness, nearness, to the top or bottom, kind of rocks it contains and other details may all be important. The few minutes taken in recording such facts may save much time and money in future work.

As an example of details concerning prospecting we will give particulars of the work done in Shaft No. 38, and Tunnel No. 39, these numbers being entered in both plan and note book. In order to avoid confusion the shafts tunnels and trenches are not entered in a separate set of numbers but are numbed in succession as the work is done. In detailing each shaft or other piece of work the sub-divisions are noted under the letters a, b, c, d, e and so on, the figures opposite the letter in the diagram giving the depth in feet or inches of each sub-division or layer, for example.

Section of the Shaft and Tunnel No.'s 38 and 39. See Note Book No. 13, Gold River, N. S.

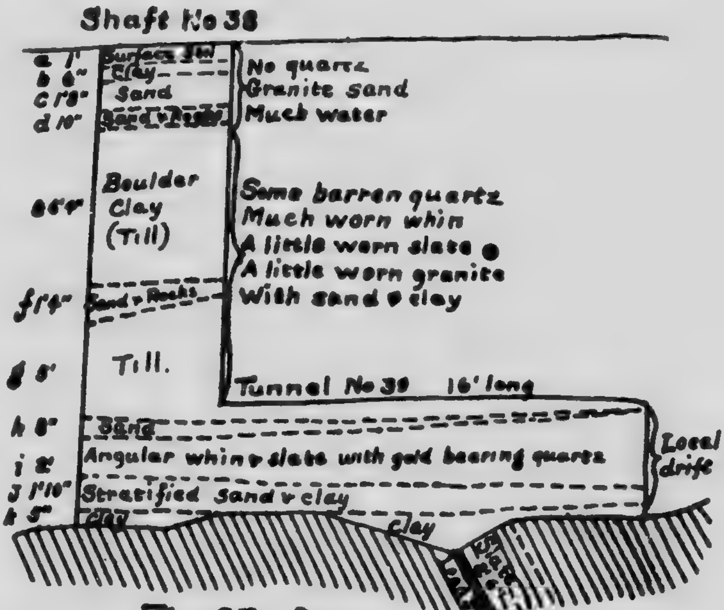


Fig. 23. Section of Shaft

In the above diagram the details are entered in much fuller language than usual to make it easier to understand. With experience symbols and signs can be more largely used and the task made easier.

Chapter XIII.

Surveys and Plans.

The old time prospector, with his hit or miss methods, despised anything like exactness and the ease with which leads and rich drift was found encouraged the feeling. But now that the moss grown ore of the past is gone, and we have only traditions of its whereabouts to guide us, we are obliged to use our wits in the game.

A good plan is a necessity in prospecting, for when deep surface hides every lead, belt, and break, the prospector is lost indeed. If Government maps are published they are often used and are found very useful. Eastward of Lunenburg. County, the country has been well mapped by Mr. E. R. Faribault. The general maps are drawn on a scale of 1 inch to 1 mile, and the district maps on a scale of 1 inch to 250 or 500 ft. These maps, and even the district plans, are on rather too small a scale to be of much service to the prospector, though they may serve to locate him and enable him to trace leads and lines. In the district plans, the structure and past mining operations are given with as much detail as the scale will allow and are valuable as far as they go. But for the prospectors use this information must be added to by a much greater detail in distribution of drift, depth of surface, location of rich boulders, and particulars of work that there is no room for in the plans mentioned. In the Western Counties very little has been done in mapping the country and there the prospector must depend largely on his own sources of information.

Therefore a special survey should be made connecting with the nearest Government marks, perhaps a cement monument or corner stakes. With surveyors compass and a little training, a man of ordinary intelligence can make a fairly good plan on which all the details of his work can be jotted down.

A vernier compass with folding sights, two levels, and a 3 1-2 inch needle, is a good instrument for such work, the cost being about $18. Get a stiff wooden tripod, each leg in one piece. Have nothing to do with wooden clamps or wooden set screws as they are almost sure to jam when damp. The glass in the compass is almost sure to be broken by rough usage or by the pressure of the sights unless very thick. So it would be wise to take out the glass by lifting the ring above it with the point of a knife, and putting in instead a sheet of thin mica such as is used in stoves. Being very elastic it will out last many glasses and not get broken in the midst of an important survey 20 miles

from the nearest glass cutter. Your compass should be carried in a stiff leather case.

To complete your surveying outfit you need a 50 or 100 ft. tape measure, and 10 white, pointed tally sticks each about 2 ft long.

A small goniometer or dip needle is also needed for measuring dips.

In starting a survey connect if possible with a government base line if one has been laid down, starting from the corner of an area. In unsurveyed districts, the starting point of your survey should be the starting point of your license or lease, or some point at a known distance and course from it.

In order to prevent mistakes, where it is suspected that iron is present in sufficient quantities to deflect the compass needle, it is safe to backsight your courses. Thus when setting up your compass for a new bearing, look back over the old bearing and see that it reads the same. For example you note a bearing as North 64 degrees East, and if no attraction exists, it should read from the other end as South 64 degrees West. If however it reads South 70 degrees West, it has been deflected 6 degrees. To find out which observation is wrong take the second bearing and backsight it. If the two last bearings correspond, the first is wrong. If not then, then the second is wrong. If there is no chance for a second bearing, go back and sight the first bearing from a distance so that you will be beyond the deflecting influence.

Sometimes in setting your compass on an old Government survey line, you find that your observation and the old course, as set down on the plan, does not agree. This is because of the variation or declination of the compass needle, the north end of which points each year a little farther east of its former position. This causes a change of about one degree in 20 years, and in time the compass needle will point to the true north pole. Then, passing to the eastern limit of its variation, it will return in several hundred years to its present variation.

In noting your work in your book, nothing elaborate is needed. A mere runing list of bearings and notes something like that used in the Government Geological Survey work will do. For example the following:—Begin at N E cor. area 321, Blk 4. N 64°E, 240′ x N 60°E, 62′ x N 86°E, 376′ x [S 20°E, 68′ to sl. blt., Dp. S 12°E ∢70°] x N 80°E, 248′ x [at 40′ mdu. to rt. 134′ at 122′ dbl.] N 22°E, 80′ to pit x N 80°E, 60′ to ld. 9″ Dp. S 10° E ∢68° x.

This means that you set your compass at the northeast corner of area 321, Block 4, and your first course or bearing was 64 degrees, east of north and the distance was 240 ft., at the end of which you set your compass

for another sight. Your next bearing was 60 degrees east of north, and the distance 62 ft. Then comes a third bearing of 86 degrees east of north, distance 376 ft. At the end of this course you enter an offset; that is you turn the sights of your compass toward a ridge of slate and find that its direction is 20 degrees east of south and its distance 68 ft. Its slanting surface dips or faces 12 degrees east of south, and the inclination of its bedding is 70 degrees from horizontal. Do not mistake the cleavage, which is nearly always vertical, for the bedding. The strike or course of the ridge or belt is always at right angles to the dip, and is therefore 10 degrees north of east, or north 80 degrees east, as it is usually given. Returning to the end of the north 86° east course, you take a new bearing, north 80 degrees east, distance 210 ft. On this last course, at 40 ft., you noticed to the right, a meadow, distance 134 ft. At 122 ft. on the same course you crossed a very small brook which you entered as a dribble. Your next course is 22 degrees east of north, distance 80 ft., to a pit sunk on a lead. Then follows a course of 80 degrees east of north, distance 60 ft., to the outcrop of the lead. Setting the compass over the foot wall of the lead, you find that it dips 10 degrees east of south and your goniometer tells you that the inclination or slant of the lead is 68 degrees. Its width is 9 inches.

In your notes you have condensed the above to less than 3 lines and saved your time and the time of your helper.

One days surveying with a helper should furnish information enough for a working plan.

In a hurried survey when you have no helper and not much accuracy is needed, pacing will enable you to make a small scale plan. A little experience will enable a careful man to do good preliminary work, in this way. A man of ordinary height and length of leg can do good work, by counting 100 paces on a good road as 96 yards, on a rough road as 94 yards, and over uneven land, or through the woods 90 to 92 yards; respectively, 288 ft., 282 ft., and 270 to 276 feet. Only experience will make possible work by this method.

In some localities drainage is a very important question, and the slope of the ground needs to be measured. Where advantage can be taken of sloping ground in a wet locality, or during a rainy season a large percentage of the cost of pumping or bailing water can be saved, and even a pump or water barrel can be dispensed with.

In levelling, a carpenters spirit level, if a good one, may be used and a fair idea of the slope obtained. To test its reliability, reverse its position and see if the bubble centres at the san spot in both positions. A hole may be bored in the bottom of a wooden level so

that it may be supported on the tripod used for the compass. This is set at the top of the slope, and sighted to a pole painted with white rings at every foot. The pole is stood upright down the slope, near enough so that the rings may be seen plainly, and so that the top of the pole will not be below the line of sight.

A *Y.* Level is however the right instrument for this purpose, and very exact work may be done with it. If the price does not prevent its possession by the prospector, it will save time and prevent mistakes. It it provided with a telescope for long distance work such as the measurement of the fall of large streams, but short slopes may also be measured. A good Y. Level, is supplied by most makers. A catalogue from any firm will give a description of these instruments, as well as others in use by the surveyor and engineer.

For putting your survey notes into the form of a plan a very simple outfit is needed costing but $2.00 or $3.00.

A horn or a celluloid protractor, transparent of course and shaped like a half circle, a wooden T square 2 ft long, a celluloid triangle 10 inches long, a three cornered scale divided into 10, 20, 30, 40, 50, and 60, divisions per inch, a H H H or a Faber No 2 pencil, a piece of rubber and drawing paper that will take either ink or a pencil are needed. For inking in the lines a drawing pen is needed and ink three colors, say red, blue and black. Better protractors can be had, circular with the degrees marked on the outer edge, or others of a larger size with the centre, 10 or 12 inches across, cut out so that the work can be done inside.

Pin down your paper, say to a board or the camp table if no proper drawing board is at hand. Start by drawing guide lines across your paper, very lightly of course, either north and south or east and west. In working out the previously noted survey they should be drawn east and west as most of the bearings incline that way. Two or three of these lines will do as there will be less to rub out. Begin your plotting by laying down the area lines, say north 80 degrees east and north 10 degrees west. To do this lay your protractor with the 90 degree mark on the guide line and with the centre of the protractor on the starting point. Then with a finely sharpened pencil mak a dot on the paper at the 80 degree mark on the protractor. Raising the protractor, rule the area line with the scale or triangle thus marking the northern line of area 321. Another line at right angles to this will mark the eastern line of area 321 and can be done with the triangle. Then place the protractor as before making a dot at the 64 degree mark. Remove the protractor again and lay the scale on the paper with the 0 mark at the starting

point. Then draw a line to the 240 ft mark on the scale and over as in the direction of the 64 degree dot on the paper. If these divisions on the scale are 40 to 1 inch your line will be 6 inches long. For the next course, north 60 degrees east you place the protractor so that the 60 degree line will pass over the dot at the end of the last course. Dot the paper at the 60 degree mark on the protractor, then lay down the scale with the 0 on end of the last course and rule the paper to the 62 ft mark. If however the protractor is not wide enough to reach this line rule a new guide line parallel to the first over the end of the first course.

When done the plan will be drawn on a scale of 1 inch to 40 ft. This will give room for details and save constant reference to the note book. On this plan should be entered the contour of the surface, drainage, distribution of gold bearing quartz, course of drift movement, (glacial markings) as well as all known leads, slate belts, and faults. The position, depth, and length of old trenches and pits should also be noted and numbered and numbers entered in the note book with further details. New pits should also be numbered in the order in which they are dug. By enclosing the reference numbers thus *(12)* they will be readily distinguished from surrounding figures preventing confusion. This reference should be accompanied by a sketch, as shewn previously, with as much detail as can be put on without crowding. Should the sketch be small it can be lettered for further reference beneath.

After all this is done the plan may be inked in to make it permanent.

To distinguish readily the different features in the plan colored inks should be used; red for leads blue for slate belts, and black for lettering and all other details. Width and dip of leads should however be noted in red with blue for the details of slate belts. Dips and courses of leads and belts, glacial markings, faults, and cleavage may be indicated by the signs used in the maps issued by the Dominion Geological Survey These may be seen at the Department of Mines at Halifax. Such details as high and low land, depth of surface, and chances for drainage, are important items in a prospectors plan.

If it is necessary to copy the plan on tracing linen a special drawing pen will be needed. This as well as everything needed for drafting may be had at Halifax. The linen is usually too smooth and glossy for the ink to stick well, so it should be rubbed with powered chalk to give it a softer and rougher surface.

Should you want to copy the plan on white paper use thin hard paper that will take either ink lines or pencil. It will be better if the plan is also thin so that the lines can be seen through both sheets. To

prepare for work close up the window except 1 or 2 square ft. Then fix a pane of glass in a slanting position a box or frame and set it in front of the opening. then lay the plan and the sheet of paper on the glass fastening them together at the upper corner with paste, fir balsam, or mucilage. This allows the copy to be lifted to see more distinctly any obscure lines or lettering. When working throw a thick cloth or blanket over your work and yourself to keep out light from behind your work.

Previous work should furnish valuable information but as a rule through careless observation the truth is hard to get at. There is also a general love of reporting a lead a little larger or a boulder a little richer than they really are. Rich boulders are also multiplied and reported from localities that leads the inquirer so far astray that much time, cash and labor are wasted. Another yarn intended to encourage the often disappointed prospector is to report rich boulders lying on or near the bed rock, thus leading him to put time and labor where it is useless. All this should be guarded against and no detail entered on the plan until you are fairly certain of its correctness, unless with a question mark (?).

Faribault's excellent maps can be used as a basis for maps on a larger scale. But as his work in the Eastern Counties is still unfinished the prospector must there depend largely on himself.

CHAPTER XIV.

Panning and Testing.

Panning has not always been considered in Nova Scotia as a branch of prospecting though in many other countries the pan has been almost as useful as the pick. A little experience will however convince the most prejudiced of its usefulness. Where few or no large pieces of the vein searched for can be found in the drift, panning is very necessary. The pan can find gold where none was visible to the pick and shovel man, and the fine gold thus found is, because of its difusion through the soil, a more certain promise of a lead near by than the 2 or 3 rich boulders on the surface.

Panning, when well done, defines the limit of gold distribution as no other method can. It sets boundaries beyond which it is useless to dig pits or trenches. The information gained makes a plan more useful and a working programme more complete. It defines the area of coarse and fine gold and gives the prospector a centre of distribution as a safe location for work It corrects false impressions gained by depending solely on the distribution of the gold bearing surface drift as a clue to the location of a rich lead. It also often confirms an opinion formed on this distribution of surface drift. Its answer is nearly always decisive in a question of this kind. Fine gold being scattered through the great body of the drift is immoveable compared to the surface boulders which are the play of ice and water. The deeper in the undisturbed drift the panning is carried the more reliable it becomes as a guide for pit sinking. It thus saves the great waste of time and labor that was formerly the rule in Nova Scotia. Much time and money has been wasted by beginning pit sinking near a rich surface boulder that was probably found from half to one mile from its source.

After mapping all the pits, leads, trenches, and other features of importance in a district, the next job is the careful panning of the drift. Tests should be taken from all the old dumps, sides of pits, and trenches in the neighborhood, as well as the beds of brooks. If dumps are scarce several small holes should be dug here and there and tests taken from them just below the surface soil. Two pans should be taken from each hole. The places panned from should be numbered and entered on the plan, with details of panning, in the note book under the same numbers. If this is done a strictly exact record is kept of the num-

ber of pans from each location and the number of sights in each pan, the composition of the drift &c; the latter as a clue to its source.

Having located the line of rich drift as well as possible from such indications the next step is to locate more exactly such rich drift by means of a trench across it; usually east and west in the Eastern Counties and from east-north-east to west-south-west in the Western Counties. This trench may be from 100 to 200 ft long and 4 to 8 ft deep. At every ft in depth and 5 ft. apart 2 pans of muck, making 1 test, should be taken. Should gold not be found in the whole length of the trench the area of work can be lessened and time and labor saved. A pail ⅔ to ¾ full will make 2 pans or 1 test. A trench 100 ft long and 6 ft deep will give 126 tests, though probably much less, as some of it, the ends probably will doubtless be barren and not worth panning.

As panning is an operation needing much care and some experience I shall include this slight description, especially as some of my readers may never have attempted it before. The articles needed are, an iron (not tin) pan known as a gold pan. Those with a ridge inside the upper edge on one side is prefered by some, although a good man will do good work without it. A tinned or copper dish will not do for the reason that it catches the quicksilver if any is used. Next a strong pocket lens or reading glass and an iron comb for taking out the smaller rocks. This last should be made in one piece with a handle 6 inches long and strong teeth turned down 2 inches, and ¼ to ⅓ of an inch apart. Lastly a small horse shoe magnet for picking out iron.

The pan should be filled level full of muck, the large stones picked out and the lumps crumbled in the hand. The pan is then filled with water and thoroughly stirred up, the small stones combed out, and an uneven half circular motion begun. The object of this is to loosen up the muck so that the heavier particles including gold will sink to the bottom. Keep up this motion for several minutes then sink the pan gently below the surface of the water. Raise it again in a slightly slanting position so that the overflowing water will carry with it the light particles on the top. At the same time tilt it slightly from side to side so that the wash will loosen the gravel and aid in carrying it away. Repeat this series of movements again and again. First fill with water, then move pan with a combined circular and sidewise motion until heavy material sinks then sink pan beneath the water, raise it in a slanting position, tilt sidewise repeatedly, lowering it as often as the water runs off until the light stuff has been washed away; then repeat circular notion as before. Move the pan fast enough, but no faster than to keep

every particle in motion and to keep the clay from forming lumps or sticking to the bottom. It must be loose enough so that the heavy material will sink through the light material to the bottom. Keep the pan inclined so that the muck will always touch one edge of the pan. When ¼ or more of the muck has been washed away more care must be used and the black sand must not be allowed to escape until all the lighter material has been washed away. The comb may be used until this stage is reached when the black sand must not be disturbed in any way except by washing. Magnetic iron if any is present may now be removed with the magnet and the washing proceeded with. As the aim is to count all the sights you will use no quicksilver. The utmost care will now be needed to prevent the gold from going away with the black sand. Little by little this sand will be washed away until the gold appears. A slight dent a few inches long made with a cold chisel near the bottom of the pan will aid in retaining the gold until the last.

Panning should be done over a small stream of running water or by the side of a pond or large pool. If the water runs in one side and out the other it will be kept clean. It may need shovelling out occasionally.

When each sight of gold becomes plainly visible proceed to count them, using a magnifying glass. Grade them as colors, sights, shotty gold and nuggets, if they vary that much, as in the following table.

1	Colors	Seen only with a magnifying glass.
2		Just visible
3		Distinctly seen.
4		Seen at a distance of several feet.
5	Sights	Form distinctly visible.
6		¼ the size of the head of a small pin.
7		⅓ " " " "
8		½ " " " "
9	Shotty gold	⅔ the size of the head of a small pin.
10		¾ " " " "
11		Size of the head of a small pin.
12		" " large pin.
13	Nuggets	1½ times the size of head of large pin.
14		Size of a small grain of wheat.
15		" large " "
16		Size of a grain of barley and upward.

As some confusion would be caused in comparing tests by counting sights without regard to size we must count one large sight as equalling several small ones. Therefore 16 of No I colors equal 1 of No 16, or 2 of No 1 and 2 of No 2 will equal 1 of No 5. As two

pans make one test the results may be added together thus.

1st pan, Seven of No. 1, four of No. 3, one No. 6 and one of No. 8, equalling respectively 7, 12, 6, and 8 of No. 1. Total 33 of No. 1 one of No. 5 equalling respectively 2, 4 and 5 of No. 1. Total for the test 44. (See note at foot of page)

While the full details are entered in the note book the totals only are necessary for the plans. When the test trench is done a sectional plan should be made showing the trench with the position and results of the pannings. This plan should be drawn on a scale of 1 inch to 4 ft. It should be ruled at each 5 ft in length and 1 inch in depth, and at the junctions of these lines should be marked the total number of sights from each test. From the distribution of the gold here shown we can tell almost exactly whether the lead is a main or cross lead. A main lead throws its gold bearing drift in flat layers with barren ground above or below. A cross lead usually, (but not always), distributes it in funnel shaped deposits spread out on the surface and narrow below as it approaches the lead. A cross lead is indicated in the section shewn, which is the result of a pan test made a few years ago.

NOTE.—The proportionate sizes is not of so much importance as distribution.

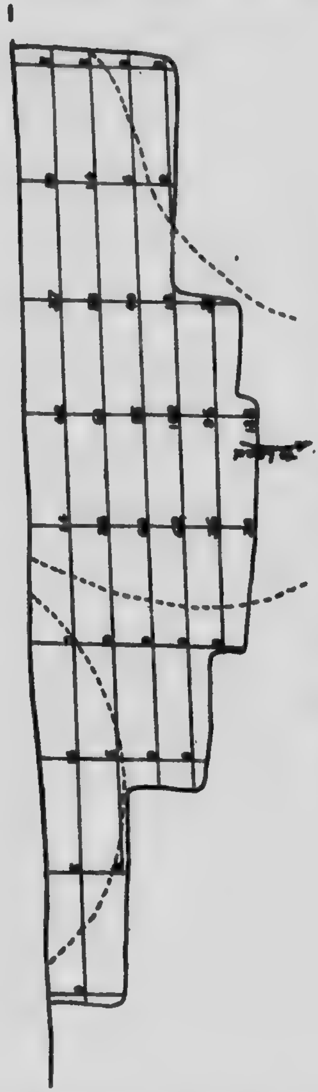


Fig 24. Section in Prospecting Trench.

In the above section the parts containing the greatest number of sights are in the line of a drift, which is probably from a cross lead, as it becomes narrower going down. The basin to one side is without doubt only a side wash from the main line of drift marking an old stream bed.

In your note book each test should be numbered thus in brackets, say (4-22) the first being the number

of the test and the last the number of colors. The test numbers can be put on the sectional plan in pencil to be rubbed out after the number of colors are put on so that one will not be mistaken for the other. Two men a panner and a helper should put through 40 pans a day.

When all is done you will be able to locate exactly on your map the centre of the line of rich drift, and will waste no time nor labor in putting down pits at random.

Combining the information from trench, dumps, and scattered boulders, locate the facts on your map. Then draw a line around the outer limit of gold distribution. Inside of this draw another line marking the outer limit of the coarse gold and richest pannings. This inner line will enclose your centre of distribution, within which, or at its northern extremity, most of your future work will be done. The kind of material among which your richest pannings and coarsest gold was found will be the character of the rock in which your rich lead will be found.

You are then ready for the heavy work of pit sinking.

Should however your time or funds not allow you to carry out a well arranged series of pan tests a small shaft is the next best test. A test shaft should always be started within the limits of the richest drift at its northern end and sunk to bed rock. A sectional plan of this shaft should be started on a scale of 1 inch to 2 ft, or large enough to contain notes on the margin, and thus save constant reference to the note book. The greatest care should be taken to note down every change in the character of the drift sunk through beside other particulars of value.

As the work proceeds the following particulars should be noted.

1st. The different layers of drift with depth, thickness, slope, composition and mode of formation of each. Number each layer on the plan for future reference and comparison.

2nd. Note absence or presence of gold bearing quartz, and appearance of quartz, sorting into different varieties and noting number of each with the size and degree of wear. Note as well all associated minerals and everything that would help to identify it when the lead from which it came is found.

3rd. Pan tests of each layer with sights graded as mentioned before and noted on margin of plan of shaft.

4th. Bed rock, its appearance, glacial markings, slope, dip and strike of beds, cleavage, dip and strike.

5th. Depth of water level and quantity of water per hour as a guide to cost.

6th. Total Number of tubs of muck hoisted and ore hoisted per day.

7th. Number of days work with depth sunk each day.

8th. Length, width and depth of shaft, cost of shaft and cost per ft.

9th. Cribbing, if any, and cost of same material and time.

(These last four items will aid in estimating the cost of future work.)

If the most gold has been found in the upper beds in this shaft then the source of it is probably some distance away and the next pits can be placed considerable distances apart and much labor be saved. There is then no need of sinking below the gold bearing layer into the barren ground beneath. If gold is present only in the bottom layer the lead searched for is not far away.

All gold bearing quartz from test shaft should be kept for comparsion with that from other shafts. They should be arranged in an orderly manner along with that containing no gold. Do not throw away a piece of quantz because it has no gold. The next piece of the same kind may be rich. The gold bearing bed of drift should be examined closely so that it will be recognized again wherever it is seen.

The plan of the test shaft can be arranged after the manner of the sketch previously leaving out the tunnel. Both margins can be used for details and the different beds lettered as references to furthur details in note book.

Chapter XV.

A Prospectors Outfit.

Now that all preparatory work has been done a few words on a prospectors outfit would not be amiss. A prospector's outfit in the 60s, would not have called for much comment. A pick, a pan, a kettle, an axe, a few lbs. of food and the never forgotten pipe, tobacco and matches nearly completed the outfit. Camp and dishes grew on every white birch and spruce tree, and every prospector knew enough to strip the bark and make them. But the possession of blankets would blast forever a man's reputation for hardihood so they were never used from April to November. Now, however all this is changed. The work is harder, the surface deeper and the prospector more particular. Now, an outfit for ordinary work will include the following with which is an estimate of cost.

1 dozen heavy cast steel single pointed picks	$ 8 40
½ dozen long handled pointed steel shovels for surface	2 70
3 short handled pointed steel shovels for underground work	2 25
1 14 lb. stone hammer	1 25
1 6 lb. striking hammer	60
1 Blacksmiths hammer	75
1 " file	75
1 " tongs	50
1 prospecting pick, extra long	1 25
1 crowbar, (1 inch.)	90
15 ft. of 7-8 inch octagon steel, (best), or ½ doz. short drills	4 60
1 miners spoon	25
1 gold pan	1 00
2 good axes	1 30
2 root axes	50
3 zinc pails	90
1 hand saw	1 40
1 long saw	2 50
2 3 cornered files	20
2 10 inch flat files	40
2 cold chisels	20
1 1½ inch carpenters chisel	80
1 1⅓ inch auger	1 50
1 ⅝ inch auger	1 00
1 carpenters hatchet	45
1 clawhammer	25
1 keg 100 lbs mixed 5 and 7 inch spikes	3 50
25 lbs 3½ inch nails	1 00
25 lbs hoop iron	70
2 bars ⅜ inch rod iron	50
1 28 lb grindstone	1 00

1 50 ft. tape measure....	25
50 ft. of 1 inch rope with grummet....	2 15
1 iron bound rocktub....	2 50
1 iron hooped water barrel....	1 25
1 6 ft. by 5 inch windlass with cranks....	1 50
1 portable forge....	10 00
1 combined anvil and vice....	4 00
Forge coal, 200 lbs....	75
Dynamite fuse and detonators for, say 20 shots....	1 60
1 diaphragm pump, 2½ inch suction....	15 00
1 spare diaphragm for pump....	3 50
10 ft. iron pipe, 2½ inch, threaded for connections....	3 00
10 ft. 2½ inch rubber suction hose, marlin wrapped....	26 00
1 pocket compass....	1 00
1 pocket lens, large....	1 00
Repair material for pump, forge, tub and windlass, Borax &c....	1 00
500 ft. narrow 1½ inch lumber for lagging, dump box &c..	6 00
200 ft. wide 1 inch lumber for spouts &c....	1 60
Camping and cooking outfit for 4 men....	14 00
At least 1 months provisions....	30 00
Trucking, Railway freight. Cost of buying and lost time....	14 00
	$184 00

It may seem to be a trifling matter to order these things perhaps, but after the prospector has been fooled by the dealers a few times the following few bits of advice may be valued. Without the least intention of doing you, in their innocence and integrity they will send you barn shovels that bend like a tin scoop, picks that hold handles that a boy could break and that wear out in 3 weeks. or cheap drill steel that cause more trouble than it is worth.

One very important bit of advice is to refuse every pick that wont take a 3 by 1¾ inch handle. Have nothing around that the men have to handle gently for fear of breaking or you will soon have some men that will not be worth 50 cts. per day. If such toys are shipped by mistake send them back at once, for every hours work with them is a loss. A story is told of an English manager in Montague who supplied his men with picks having light handles so slight that they were constantly breaking. On being told of it he gave orders that the men be more careful of the handles. On his next inspection he found fault because the men had done so little work and was told that they were afraid of breaking their pick handles. This brought a supply of picks that would take handles the men could not break. The same may be said of the shovel handles, they must be strong. The make of the shovels is another important point. You need the strongest made heavy in the centre where it first breaks, 14 inches long and sharp pointed so that you will not die of old age

while a greenhorn is trying to stick it into a pile of slate.

One cannot be too careful in his selection of picks. The miserable things with a few inches of thin steel attached are not worth paying freight on and are sold by the dealers because they wear out quick and make business for them. Demand picks with 11 inches of good steel 1¼ inch by 1 inch thick to work on before they are used up. Get single pointed picks. Double pointed picks with this amount of steel are too heavy for ordinary work and cannot be used in a tunnel anyway.

Get a 14 lb stone hammer, it will save dynamite. A 16 lb rock hammer in the hands of an able man will do up a rock that an inch of dynamite will hardly smash, but 16 lbs is too heavy for the ordinary man.

A good crowbar is very useful and will save many pick points where greenhorns are present. This kind of a ——— delights in sticking newly sharpened picks into tight cracks and snapping the points off to show what a poor blacksmith you have. He is the limit, and should be drowned with the man who uses the sharpest axe to chop roots where rocks are plentiful.

If you have only one striking hammer let it be a 6 lb. hammer. Youngsters can learn to strike with it while a heavy man can do good work with it. Have a strong handle for your crowd will likely contain new hands who have no admiration for the limber of a good handle. Also it will cost less for handles.

Do not forget a good blacksmiths file for like charity it hides a lot of bad work.

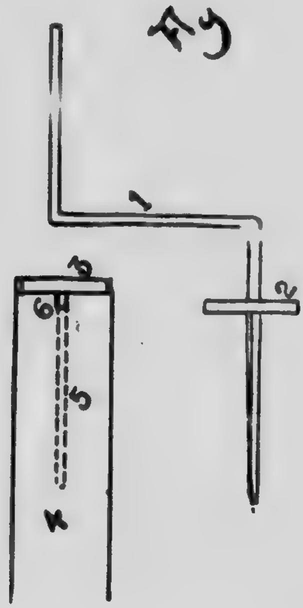
If your crowd contains a blacksmith he can make your tongs, chisels, spoons, drills, grummet, windlass and rock tube.

Get a good handsaw as you may not be near enough to a neighbor to borrow in case of breakage.

A 2 1-2 inch pump soon pays for itself in a wet place, as after a heavy rain a single water barrel is seldom equal to the task. A pump therefore in most places is an urgent necessity. The cost of time lost in the morning by a crowd of men waiting for a dry pit will soon pay for a pump. In shallow pits and trenches a 2 1-2 or 3 inch pipe and a pole, with a piece of leather attached to fill the pipe may do in place of a pump, where there there is not much water. An Edson No. 3 diaphragm pump with 2 1-2 inch suction is provided with a rubber diaphragm worked by a lever. This is a very serviceable machine if gravel is not allowed to enter and cut the rubber. In case of accidents like this a spare diaphragm, should always be kept on hand.

There are several ways of fastening windlass cranks, some of which are bad and some worse. One

of the strongest and most durable is shown in the following sketch.



1.—Crank of 7-8 iron, from turn to the end that is driven in windlass barrel is 18 inch.

2.—Cross-piece 7-8 thick and 6 inches long welded to crank and set in slot in top of barrel to keep it from turning on the crank.

3.—Ring to keep cross-piece in place.

4.—Windlass barrel.

5.—Hole bored in barrel 12 inches to put end of crank in.

6.—Slot 2 inches deep and 1 inch wide to hold cross piece on crank. Drive in sharp end of crank as far as it will go. If hole is too deep crank will be loose.

If you have a difficult job it is no economy to use a pocket compass and expect to do good work. The main lines of your survey at least must be laid down with a good compass. A compass like the one described on a previous page, will cost about $18.00 and a tripod about $5.00.

2 or 3 barrels of hard biscuit should be included in the list of supplies as it will save much work and one mans' time baking.

CHAPTER XVI.

Working Methods.

How to dig. A very simple thing we think. Any-one can do it who cannot do anything else. Yes they do it, but some men can dig nearly twice as much as others. This is a fact worth remembering because it means that some men do not know how to dig and others do. You lose money on the man who does not know how to dig, though if he is willing to take a little training he may in time be your best man.

Even such a simple thing as digging needs to be learned. First the tools, a well made well tempered 5 lb pick with a good handle slightly flattened so that it will not not turn in the hand, and not too long. In trenching drive your pick in the earth as you would a set of holes in a stope. Take out your centre piece, then your corners will come out easily as in the diagram.

Prospecting Trench

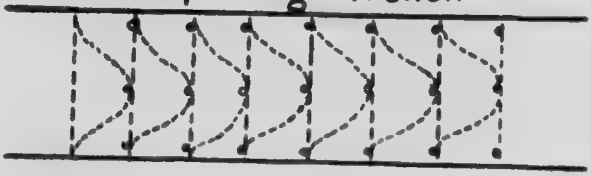


Fig 26 Horizontal Section

Three blows by a good workman often takes out a section across a narrow trench while a poor workman takes twice the time picking at random If the centre piece does not come out at the first blow, unless a rock is in the way, try it again. Make this your motto "Never use two motions were one will do," because it takes time. Use you brains to save your muscles and increase your work. You will understand the aim of this better if your read Frederick Taylor's articles on Scientific Management running through the Amercian magazines.

In sinking a pit in wet ground do nearly all your work in the centre as the sides crumble and fall in themselves and often the utmost care is necessary to keep it from caving.

In a surface tunnel put only your best man, especially if the ground is wet and caving. The best man is of course the man who can drive the greatest number of feet in the shortest time, and will do it with the least labor and by removing the least earth. In dry or fairly dry ground he gets down on his knees, and using a small pick with a 2 ft. handle he digs a horse shoe shaped tunnel that is not much higher then his head. I have no use in a surface tunnel for a man who wants room to stand up and swing a long handle pick. Though he may be a splendid man in a trench it would take two helpers to keep his muck clear in a tunnel and three to dig him out when the roof caved in and buried him. If not, he would not advance half as far as the man in the small tunnel.

In shovelling in a tunnel the new hand has something to learn also. He should use a shovel with a handle sawed off at about 2 ft 2 inches from the blade and a wide 9 inch peice of wood nailed across the end. He can bring the weight of his body to bear on this by leaning forward and and thus lessen by over half the work his arms have to do. Not only can he do more work in this way but he can do it easier, the combination of weight and strength will force the shovel easily into very compacts masses of earth and rock easier. The tunnel being made narrow to save work, he throws the muck behind him over his shoulder. He thus advances faster and his helper has less muck to carry out and more time for other work than in a large tunnel.

In a wet shaft the mucker will shovel under water as the water lessens the weight of the muck by nearly half.

In shovelling from a deck also something can be learned, for here as well as elsewhere a good man can do twice as much as a poor one and do it easier because he knows how. These few words are a confidential chat to the poor workman, especially those who do not know how poor they are until somebody measures their work. The idea most common in a boss's mind is not, "Have you done a good days work" but, "Have you worked every minute." So the good man gets little encouragement.

Again I would refer to the rule, "Never use two motions where one will do". Observe the awkward shoveller. He makes movements with the shovel before he gets it full. Then he raises it, turns around takes two or three shuffling steps, empties the shovel on the dump, repeats the shuffle and returns the shovel to its former position.

There are several extra and needless movements in this act and needless movement takes time as well as

effort. The good workman saves these movements, as well as his strength and time. He places his right foot where it can be used as a pivot, usually about 4½ ft from the muck. With the shovel resting across his left leg he swings sh[illegible] leg, and body forward at the same time. The force of this swing of leg and body drives the shov[illegible]l beneath the muck with hardly any exertion by or strain on the arms. The left foot then rests about 2½ ft in advance of the right foot and the shovel is full with only one movement. Another swing backward and to the left carries the body, leg and shovel around and plants the left foot about 2½ ft behind the right foot which does not move. The force of this swing will carry the muck off the shovel and on the dump. A forward movement will return the shovel to the muck and fill it again. Thus in two movements and half the time, is done the same work that the awkward shoveller does with twice the labor and three times the number of motions. After a little practice the body works with the ease and regularity of a machine. The amount of work done per hour is greatly increased without a corresponding increase of e[illegible]ort, and the worker if he is not rewarded by an increase of wages at least deserves it. And not only is the workman not so tired but if he chooses he has far more time to rest, the only drawback is that an ignorant boss will think he is loafing.

All prospectors naturally have to break rock and some become very expert at it. Some men break rock easily that others cannot break with the utmost efforts. I have had light weight workmen who could with a 12 or 14 lb hammer break rocks that a man 50 lbs heavier and much stronger could not break a splinter from. Therefore there must be a know how in this simple job also. Nothing affects the pride of a big man so much as to see a small man doing things (needing only muscle as he thinks,) that he cannot do himself. And nothing annoys his employer so much as to see him too proud to learn. The rock breaker usually hits his rock any where and every where pounding away with main strength and stupidity.

He should first select and turn up the flattest side, turning the most prominent edge to the left. Using the edge of a square headed hammer, (never the face,) he strikes a series of blows in a straight line along the flat surface about 2½ or 3 inches from the edge. When it is well scored along strike several heavy blows in the centre of the line directing the force of the blows toward the left and away from the centre of the boulder. This should split an ordinary w[illegible]oulder. A granite will probably need furthe[illegible] Trap and diabase are even harder to break [illegible]anite, but the first

is scarce and the last very rare in this part of Nova Scotia. Only two dikes are known to me and these lie on the islands and coasts of Lunenburg and Queens Counties and across the anticiine at Tangier. Never strike on a rounded surface unless there is no flat or fairly flat surface to strike on.

A little attention will soon show you which of your men are the most valuable. It is the speedy intelligent worker who reduces the cost of work, a sufficent reason why I should refer to such a simple part of the prospector duties.

Chapter XVII.

Tracing the Drift.

After the preliminary work, survey, pan tests or test shaft, has been completed the regular work of trenching and sinking is begun. This is the beginning of the real struggle with nature; when the prospector must use his wits as well as his hands. The mere sinking of pits and digging of trenches without order is not prospecting. Good work in this line means the carrying out of a programme arranged after having gained a fair knowledge of local rock structure and the distribution of the drift covering the bed rock.

If gold bearing quartz is found on the surface it will be a good guide for awhile, but when this disappears recourse must be had to sinking. For this work a programme can be arranged employing 4 or 5 men to carry through.

It is now that the knowledge gained in the test shaft or trench can be made use of. Gold in the upper layers only, mean in a deep surface the extension of the work to a considerable distance north or perhaps northwest. Therefore the first pit may be started from 75 to 150 ft., from the test pit or trench in the supposed line of drift. If gold is present only in the lowest layer or near the bottom then the advance must be made carefully and the pits sunk at short intervals in order not to overstep the lead. Should the gold be distributed sparingly throughout the whole depth of the drift, its source will probably be a considerable distance away, and the job will consist as much in tracing that particular bed of drift as the gold it contains. If only one loose boulder with gold has been found, without pan gold its source may be miles away.

The arrangement of the pits needed in most cases is shown in Fig. 27. The first shaft north of the test shaft is followed by one on either side to find out how wide the line of drift is. It is found in this case to extend beyond No. 2, on the left, but not to reach No. 3 on the right. Then the next row of 3 pits is extended more to the left, but it is found that the gold does not reach No. 6, the extreme pit on that side. They need not be sunk deeper than the layer of drift gold in the test pit or trench. If a trench has been dug across the line of drift as already described, the outer pits, Nos. 2, 3, 5 and 6, will not be needed for the boundaries of the line of drift will be defined without them. If gold bearing quartz, is not found as the work advances use

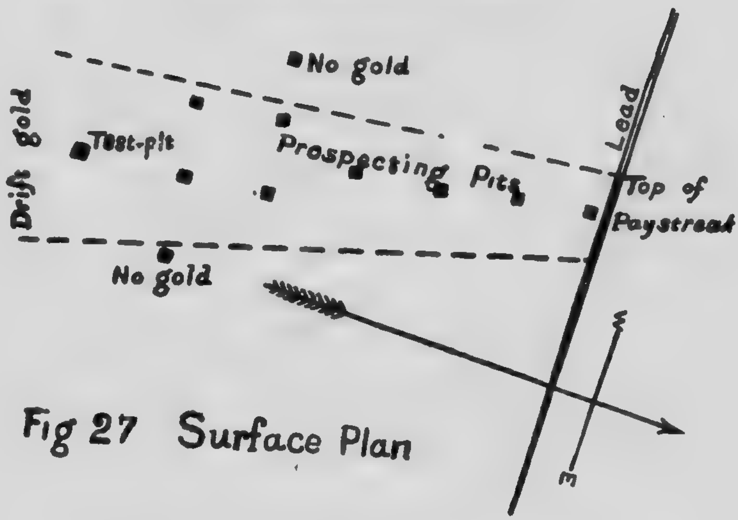


Fig 27 Surface Plan

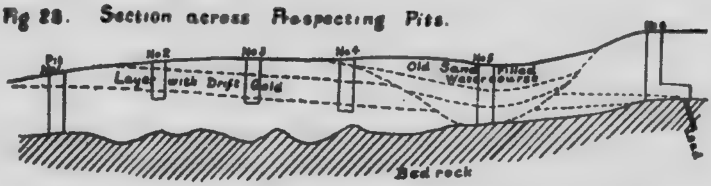
the pan to make sure of its presence or absence. As the gold is distributed from the paystreak in a slightly fanshaped form, the ground to be prospected becomes narrower, as the work proceeds. Therefore more care is needed to keep in the course of the drift as the work advances. Often just before the lead is reached there is a complete absence of gold bearing drift, and we are led to think that we have passed the lead. It often happens that the last traces of loose ore is pushed far over the lead, and for this reason prospecting has often been stopped, before reaching the lead searched for; or perhaps another lead has been mistaken for the lead searched for. However this condition is not so frequent that we need take it as a rule of action.

The use of the pan here will often decide the question of gold or no gold when gold bearing quartz is absent. The clay in crevices, hollows, and on the south side of small ridges, often contain gold when the bulk of the gold bearing drift has been carried farther.

Accidents of nature must be expected. For example an ancient watercourse may have crossed the line of drift and left a wide deep belt of deposits, of an altogether different kind, from that before worked in. A complete absence of gold in this belt of drift may lead you to think, that you have passed the lead. In these watercourses, sand, gravel, and waterworn rocks in layers will convince you that something out of the usual course of events has happened. A watercourse like this hindered the finding of the rich lead at West Caledonia. The rich boulders of the Touquoy

lead, at Gold River, have been scattered by a maze of watercourses and the lead from which they came is still hidden. Prospecting has often been begun in modified drift like this, and in that case tracing the gold bearing boulders to their source has been an almost impossible task. In view ot these difficulties a man must be skillled in reading these books ot nature, before he can hope to solve all the riddles laid before him. Much on this subject is said in the chapter on Surface Geology.

Fig 28. Section across Prospecting Pits.



Layer of gold bearing drift crossed by watercourse.

Here the prospecting was done in gold bearing drift, until pit No. 5 was reached, when the gold was absent even in the pan tests.

The drift also was of a totally different nature, consisting of water worn rocks, gravel, and sand instead of boulder clay—A suspicion of the truth led the prospectors to sink another shaft No. 6, when gold bearing drift was struck again and finally the lead was found.

Approaching the lead from which the rich drift came, the gold will be found on or near the bed rock. Here the utmost care is needed in tracing the gold because it is often absent near the lead from which it came. This is more likely to be the case when the lead occupies a ridge, or even a slight elevation in the bed rock, from which the gold has been swept into the next hollow.

After the test shaft has been sunk no shaft needs to be sunk below the bed carrying the gold. The dominant idea in the whole work may be expressed in the words, "Follow the gold," don't do otherwise except under expert advice It is a waste of time and money to sink pits below the gold bearing layer unless you have good reason to think that a like layer or a lead lies beneath.

Of course we must not expect to find a perfectly orderly arrangement of beds in any one section of ground· Some pits will contain more or less beds than others. But the corresponding beds in each pit may be identified, sometimes by means of a peculiar kind of rock or ore, its waterworn condition or general compositon. Often a bed of rusty broken rock or

gravel can be traced through many pits. Then it is not uncommon to find two layers in the same pit containing gold. These may be from two leads, one of them quite near and the other further away: or they may both be from the same lead eroded at two widely separated periods of time. Or again, they may be from two leads lying in different directions and transported at two different periods as before. Conditions like the foregoing are however not common as the drift from two neighboring leads are often mixed.

While this work of pit sinking is going on there should be some way of showing clearly at a glance the progress made. The discoveries already made are the best guides for the work ahead. For this purpose a sectional plan should be madeon a scale of about 10 ft to 1 inch. This plan should be long enough to include all the pits and trenches sunk on the line of drift. If the pits cover a large area, and the plan must be made on a small scale, then a plan of each pit should be kept on which all small details can be shown. Note on these tl different beds, their width, composition, finds of ri quartz, and panning records. These should be compared from time to time and the information gained applied to the work in hand. In deep surface such a record is necessary as mistakes made under such condition are often costly. By means of such a section the gold bearing bed could be traced through every pit, if present, and much information recorded that would aid in the identification of the other beds.

The above is of course a deep surface programme. In shallow surface an open trench to bedrock would not be costly.

Until lately not very many prospectors could tell the difference between main or bedded lead boulders, and those from cross or fissure leads, when the latter showed the same seamy irregular dark lines that the main leads showed. This mistake was made in many districts especially Blockhouse, Brookfield and Oldham. It often led to an enormous waste of time and labor and usually ended in a failure. As the fissure leads usually run across the bedding, it frequently happened as it did at Blockhouse, that a prospecting, trench or tunnel was driven parallel with and a few feet from the lead searched for. On the advice of old prospectors the work was always carried due north. These old and experienced prospectors also had their innings in this work but the result was usually some more age and experience.

CHAPTER XVIII.

Pay Streaks and the Location of Mines.

And now though you have found the spot from which your rich boulders came, do not be cocksure before examining it thoroughly that you have the top of a paysteak of unfathomable depth. There are exceptions to nearly every rule, and though the Brookfield and other paystreaks reach down thousands of ft, yours may only be a surface spot. If, as T.A. Rickard says, all ore deposits are only spots, then mining men are well satisfied, with such spots as are found in South Africa, some of which have been mined down to 7000 ft on the inclines. Even a spot large enough to give several thousands dollars profit before being worked out is very acceptable, at any rate to the small investor. And when spots in Nova Scotia reach down over 2000 ft we should take heart again.

This idea that surface spots are the only torm of gold deposits in Nova Scotia has got abroad and foreign capitatists witnout investigation have believed it. We hear much of spots from those without money to prove their contention. Until a thorough search has been made no deposit can be proved to be only a spot and not a paystreak. Until proved the doubt remains a doubt.

It is well known that many paystreaks consist of a succession of spots slightly or not at all connected, or overlapping with intervals of barren rock between. Such was Brookfield, and when McGuire worked out the first rich spot. knockers said our mines were spotty. Yet a 10 ft tunnel showed up a 2000 ft paystreak good to the last foot.

Ignorance of the dip of paystreaks has led to many failures in mining in Nova Scotia and to repeated assertions that our gold mines are only surface spots, never reaching to the depth they do in other countries. Old and experienced managers have repeatedly sunk vertical shaft or shafts on the dip with the one idea of getting deeper regardless of the fact that paystreaks or spots as they choose to call them usually incline either to the right or to the left. They were too old to learn. Structural Geology, the base of every good Mining Engineers reputation, was despised by these moss grown relics of early gold mining.

A knowledge of the dip of paystreaks is a very important part of a prospectors stock in trade Slightly dipping paystreaks have often been cut through and

found barren below. Such a streak was that of the Baker lead at Gold River, which dipped about 1 ft in 12 or 14 and was followed about 1000 ft to the west.

Paystreaks on fissure leads nearly always dip away from the saddle following a mineralized belt, as at Blockhouse and Cow Bay, or the junction with another lead as at Brookfield. or a zone of shattered rock containing angulars. These fissure paystreaks will peter out as the distance from the saddle increases, but new paystreaks will probabiy come in below with each important junction with underlying leads.

These paystreaks seem to owe their origin to one of the following causes. Ist, a mineralized belt as at Blockhouse. 2nd., a zone of shattered rock filled with angulars as at the Micmac Mine, Leipsigate. 3rd., a crumple crossed by angulars as at the Crease Mine, Mt. Uniacke. 4th., a large crumple or curve as at Goldenville. 5th., a crosslead as at the Paton Mine, Pleasant River Barrens. 6th., a Main or bedded lead as at the Libbey Mine, Brookfield.

In prospecting for the outcrop of these paystreaks seek the junction of two leads or belts as mentioned before. A line of rich drift, pointing to such a junction, often furnishes a valuable hint as to the location of a rich spot. Mr. Faribault's district plans will often prove valuable in showing where these junctions are apt to be found.

The only satisfactory way of mining these slanting paystreaks is by means of inclines. The Blockhouse Mine is an example showing the folly of sinking vertical shafts on an inclined paystreak.

A few of Mr. Faribault's comments, on the Cow Bay leads may be of interest as several other leads still undiscovered are of probably the same nature. "All the veins here are true fissure veins running north and south. The present developments prove that all these fissure veins are more gold bearing where they cross a highly mineralized belt of feldspathic whin about 100 ft. wide, situated at the contact of the the upper slate with the underlying whin group. Some layers are so heavily charged with magnetic pyrites as to affect the needle of the compass. This mineralized belt dips to the south at an angle of 35 degrees from the horizon. The paystreaks of the veins will necessarily dip south, at the same low angle and may be developed on that incline at a great depth. No doubt many of the failures met with in the present operations, are due to the ignorance of this important fact."

Having now satisfied yourself, as to the presence and dip of a paystreak the next important job is the starting of a shaft or incline. A mistake on this point

is often a costly mistake. By means of small pits you will get the length of your pay ore on the surface. The pits at either end of the ore body will give its inclination, if they are deepened and stoped a little. But as this is an awkward, and time consuming way, you should get expert advice, for the loss occasioned by an illplaced and poorly started main shaft, will more than repay any extra cost. If the lead is a fissure, the form and direction of the ore bodies will probably be governed by one of the rules given above.

Even when the question of a shaft, or an incline is decided a mine may be ruined, by want of foresight. The prospector as a rule does not care whether the shaft is in high or low ground, or in a hole that is liable to be flooded by the first rain. Usually the working shaft is located wherever the lead happens to be richest or largest, it may be in a swamp or beside a brook, where the cost of pumping eats up the profits. A careful examination of the ground should be made and the highest part of the lead selected as the site of the main shaft or incline.

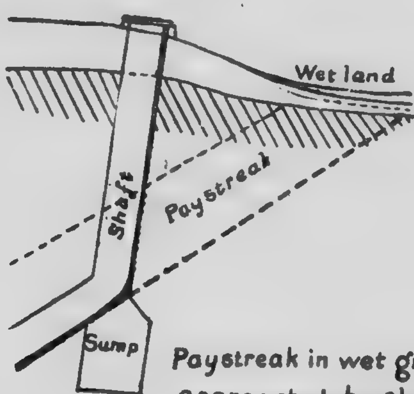
When an inclined paystreak starts in a wet place it is better to approach it by a slightly inclined shaft, on higher ground, if that site lies over the paystreak, as in Fig. 28. By having the shaft inclined in the same direction as the incline, the one system of haulage will do for both. With a vertical shaft over an incline, while you will fit the incline with a track, the vertical shaft must be fitted with guides, which will call for suitable fittings, for the car or skip. The slightly inclined shaft can be fitted the same as the incline with a track, and the addition perhaps of outer guides.

If the paystreaks dip away from the high ground then a long incline with a slight slope can be driven beneath the paystreak, until it strikes it in solid ground. See Fig 30. This may be considered as an expensive job, but anything is cheaper than the continual outlay for fuel, time, pump repairs, and other drawbacks that lasts for years, and all for want of a little foresight. In a wet country like Nova Scotia, this point is very important.

If you need a shaft on a nearly vertical paystreak that descends in a low place it is best to approach the place through an incline from the nearest high ground on the range of the lead, striking the ore at some depth. Then blast a sump at the junctions of the shaft and incline to retain the surface water, as it will take less power to raise it from here, than when it descends lower. There is the same necessity for having a sump near the surface in all mines as the one great drawback in Nova Scotian mines is the over abundance of water.

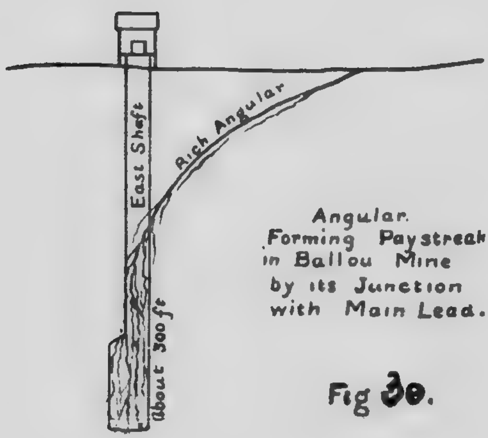
If it is not possible to have the incline or shaft in a dry place the only recourse is a coffer dam, inside of which you sink your shaft. A description of this is too long to enter here but accounts of such jobs have been published from time to time and an examination of the Mining Societies, journals will doubtless find you what you want.

The angular forming the paystreak in the Ballou mine began in a narrow belt of rock but gradually divided and spread until it made gold bearing a belt of rock 14 to 16 ft. wide and nearly 40 ft long.



Paystreak in wet ground approached by shaft.

Fig 29. Section.



Angular. Forming Paystreak in Ballou Mine by its Junction with Main Lead.

Fig 30.

In the Crease Mine, Mount Uniacke a crumple dipping slightly to the west was the seat of a rich roll. It continued along the crumple for a considerable distance. It is the opinion among the best authorities that this crumple in the underlying leads also contains rich ore, and that a number of leads with this short fold in them would be found by sinking.

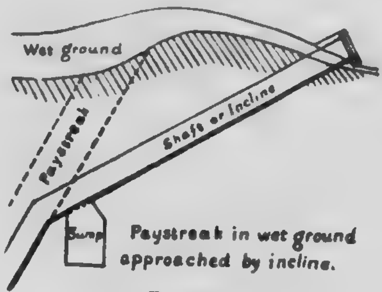


Fig 31. Section.

In the Libbey Mine the paystreak consisted of a number of rich spots separated by small pinches or but slightly connected by stringers of ore. The paystreak has been formed by the intersection of a fissure and a main lead. The fissure having the steepest dip the paystreak lies closer to its outcrop than to the main lead. See Figs 33 and 34.

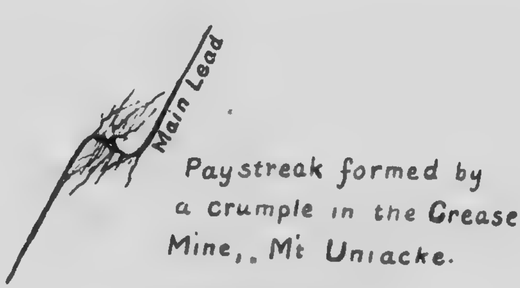


Fig 32. Section.

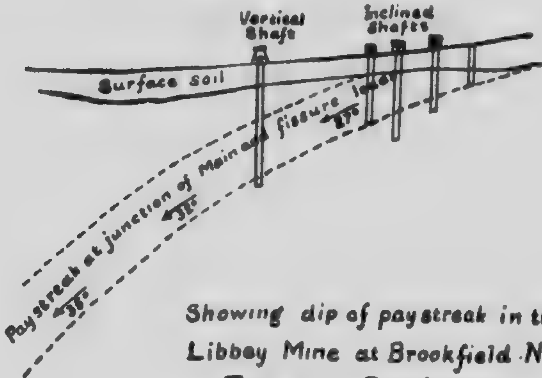


Fig 33. Section.

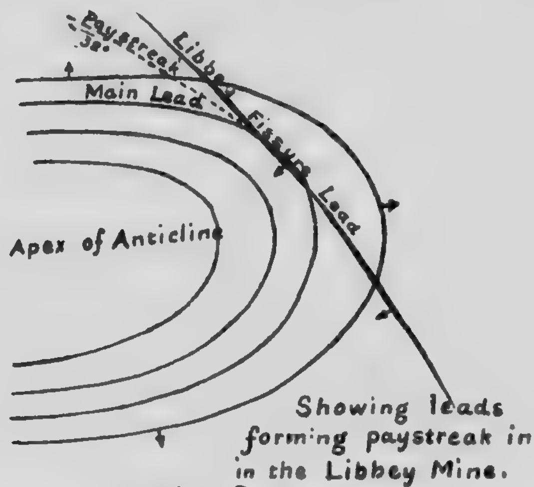


Fig 34. Surface Plan.

It crosses the end of an anticline, as does the Block house lead and some others.

At Mt Uniacke the paystreaks follow undulations across the leads. There are four, three of which dip east and one west.

At Blockhouse the paystreak was on the largest part of the fissure and at its intersection with a belt of mineralized slate. The values are very evenly distributed throughout the vein as far as the mines has been sunk; a character indicating permanence. Of the same nature is the Cow Bay fissure, though the latter does not give us as large a quantity of ore. A vein belonging to the same class has been opened at Voglers Cove but the values are more unevenly disposed.

At Renfrew the paystreaks are found along undulations branching of from the main fold. Some of these paystreaks have been very rich, especially the Thompson Mine, which is said to have netted the owner over $50.000 in two months. See Fig 36. Of the same character are the paystreaks at Goldenville, Mt Uniacke and elsewhere, In fact the majority of the paystreaks in the Eastern Counties belong to this class. The dip of the lead has little to do with the dip of the paystreak for the dip of many of the Renfrew leads are almost flat while at Mt Uniacke they are vertical. See Fig 35.

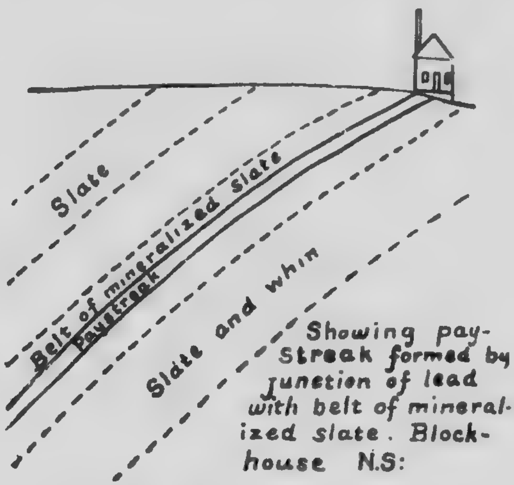


Fig 35. Section along lead.

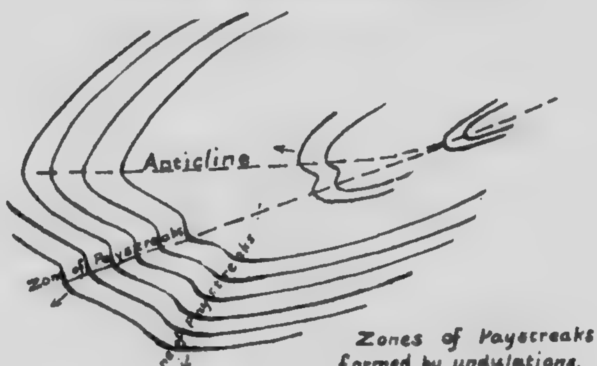


Fig 36. Surface Plan.

CHAPTER XIX.

Economical Timbering.

As the cost of timbering bad ground is often a quite important item something should be said about it. Where the roads are bad, economy in this line is often necessary. A method of timbering or cribbing where by the lagging from one shaft to another can be taken out and used in another is more valuable to the prospector than to the miner. The method figured below I have used for a great many years and found it the most convenient I have ever known. I have seldom ever seen it used in Eastern America therefore it will doubtless be new to many and I will give it a short description. Some such method as this is badly needed in quicksand and in wet clay and gravel. With this style of cribbing the same lagging can be used, withdrawn, and used again in each succeeding pit.

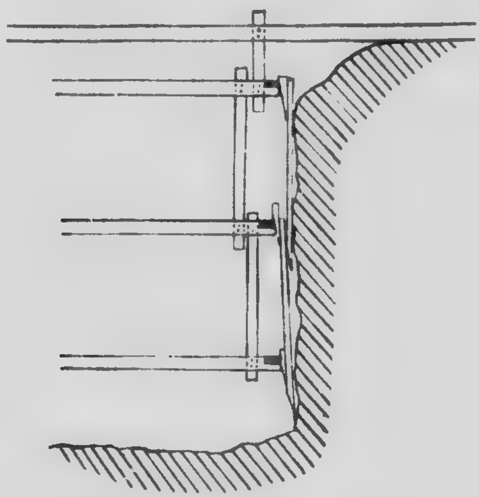


Fig 37. Vertical Section.

After the pit has been sunk, say 6 or 8 ft, the deck timbers are laid across. Then a set of timber is framed the size of the working space, spiked together, and lowered into place. It is hung by means of short pieces of wood to the deck timbers just below the surface of the soil. Then another set is framed and hung to the first set and about 3 ft below. 1½ inch deal is then cut

into 4 ft lengths, sharpened with a flat levelled or chisel shaped edge, and put behind the sets with the bevelled side toward the pit. It is wedged back with wedges 2 inches thick at the top as shown in the diagram. The wedges keep the lagging back from the timber and allows space for the insertion of more lagging. When another set is put in the wedges are pulled out, the lagging put in their places, and the wedges replaced between the lagging and the set. If the ground is liable to cave, the lagging is driven in advance of the work. One piece of lagging needs two wedges, one at the bottom. The wedge at the bottom of the lower lagging is driven far enough so that when it is taken out there will be space enough left to put in another piece of 1½ inch lagging, besides sticking the point of of the wedge between it and the set, In quicksands, or watersoaked clay, the lagging should be closely matched and the sets of the same dimensions outside and evenly hung.

When the shaft is to be deserted the wedges can be driven up with a small hammer and the loosened lagging thrown into a tub and hoisted. With the help of one man I have taken all the lagging from a 22 ft shaft in less than half an hour to have it for use at the next pit.

The lagging should be of spruce if the ground is very bad, and instead of a wedge behind the last set driven in to the full length another length of lagging should be driven down ahead of the work. Thus the ground behind it will remain closely packed and the danger from caving be less. Use 5 inch spikes for timbers and 4 inch for hangers.

It is a most difficult job to start a tunnel from the bottom of a pit, in quicksand or other bad ground, and unless the surface is deep it pays better to sink another pit within a few feet of the last. The two can be connected by a short tunnel into which there is no need to enter. In bad ground a form of cribbing much like that for pits may be used to advantage. It also can be withdrawn when the tunnel is finished. Greater care must however be taken in keeping the lagging closely matched and driven ahead of the work, as caving behind the lagging may destroy the tunnel.

In starting a tunnel from the bottom of a cribbed pit, clean up the bottom and put the last set on the bed rock, driving the lagging down close all around. Then make two tunnel sets of 3 pieces each and high enough to reach within 4 inches of the bottom of the 3rd set, or from 4½ to 6 ft high. This space of 4 inches is needed to drive in the roof lagging for the tunnel. Then loosen the wedges, one at a time, and drive the lagging below the set until there is room to drive in horizontally 1½ inch pieces of lagging of the same

length as that cut for the pit. Drive them as far as they will go and they will support the stuff behind the pit lagging as well as act as a roof for a tunnel. To keep them up until the tunnel sets are in put a 1½ inch piece along beneath them and spike it fast to the bottom of the pit set.

Then a 2½ or 3 inch pole, long enough to reach from the set above to the bottom, is spiked fast on the sides. Leave space enough behind it to drive in the side lagging removing the upright pit lagging from the corners so this can be done. The end of the middle set is then sawn out, allowing the pit lagging to collapse. When this is removed the way is open for the tunnel. As soon as there is room enough the first tunnel set is put in behind the shaft cribbing, and the bottom kept by a sill wedged in between the uprights see Fig 38. As the digging proceeds the set is driven back until there is room enough to drive wedges

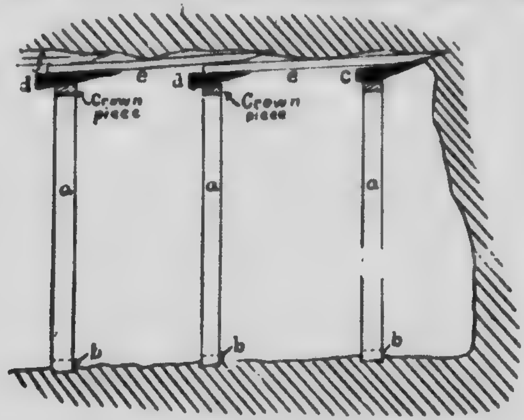


Fig 38. Tunnel cribbing, side view.

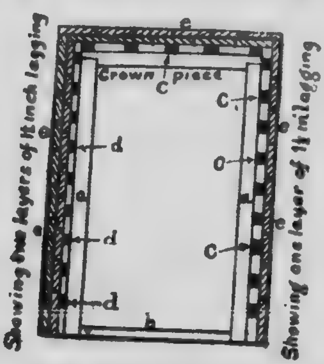


Fig 39. Cribbing End view

between this set and the lagging as illustrated. This should be done as soon as possible because when the full weight of the earth behind comes against the top of the lagging it may be impossible to drive in wedges. Then the digging is resumed until the set is back as far as necessary when preparations are made for the insertion of a new set. The tunnel lagging is handled the same as the pit lagging the wedges being pulled out to give place to lagging on top and sides and then replaced but only driven in this time far enough to loosen the lagging when withdrawn again, See Fig 39.

a. Represents Uprights
b. " Sills
c. Represents Wedges driven in full length behind one layer of lagging.
d. Represents Wedges driven in front of two layers of lagging.

One side of Fig 38 shows one layer of lagging inserted as at e in Fig 38 The other side shows overlapping as at f in Fig 38. The top of Fig 38 shows the two conditions.

I would repeat here this advice, always keep the tunnel lagging ahead of the work.

CHAPTER XX.

Surface Prospecting vs Underground Prospecting

There has been much argument over the benefits of surface prospecting as against rock tunneling from shafts.

The advocates of deep tunneling say—

1st. The work is more thoroughly done and every vein is cut.

2nd. There is more protection from the weather and no time is lost through rain or storm.

3rd. The ground covered by swamps and streams can be cut while such places are often skipped by surface prospectors.

4th. No leads will be passed over as in careless surface work, or where leads are capped on the surface.

5th. By sinking on a lead a lot of ore may be recovered which would go toward the payment of expenses if the lead carries gold.

The supporters of surface prospecting maintain;—

1. That rock tunneling, with its necessary shafts and machinery, would cost at least $15.00 per linear ft.; while surface prospecting will not average more than 75cts per ft., pits and tunnels included.

2. That $100 will only explore about 67 feet of ground by the first, but it will pay for over 1300 feet by the last method.

3. By the first method 4 men could drive only about 20ft. in 20 days including shafts, sinking, timbering, cutting fuel &c, while 3 men could easily do 120 ft. of surface work in 20 days.

4. A surface cost of machinery, timber, fuel, ammunition, and shaft sinking would be nearly all saved in surface prospecting.

5. A surface prospector would be searching for something definite in the shape of a lead from which rich drift was thrown, and which he is on the track of, while the the underground prospector is working solely on the chance that a paystreak or good spot may intersect his tunnel.

6. The surface worker would have speedier results and quicker returns without a large expenditure of capital.

7. A good prospector passes over no leads. If the pick does not decide the question, dynamite will.

8. If leads are often capped over over or pinched

out on the surface they are just as liable to be pinched out below, for this is a local condition and liable to happen anywhere on the surface or below.

9. To sink 50 to 100 ft. on a lead of barren or low grade ore in the vain hope of striking a bonanza or even paying expenses is only a gamblers chance or even worse, or perhaps a contractors scheme to make a job last.

10. A paystreak or shaft showing good ore at the surface may not be cut below for the reason that paystreaks nearly all dip to the left or right.

11. Leads in swamps may be cut with the help of a coffer dam which will not cost $15.00 per ft., or cheaper with a diamond drill.

12. As a final argument, the day is past when money for such expensive work as rock tunneling from a shaft, can be raised in Nova Scotia, except when such a tunnel is started from a proved and profitable mine.

There is of course a chance, a very slim one, of striking good ore in depth in a deep prospecting shaft or rock tunnel where none is found on the surface, but why take such chances when you do not have to. Considering that not one lead in one hundred has pay ore in it and probably not one in forty gold bearing leads will pay, the most reckless gambler would hardly take such risks with the chances so much against him. So neither the thoroughness of the work nor any other advantage would outweigh the risks in spending a so much greater amount of money with the chances so much against the investor.

A far less amount of money spent in surface work in search of a definite object, a certain lead known to exist, even if a temporary failure, could be borne by the average business man without danger of financial ruin. Lucky is the man who succeeds in raising money for surface prospecting in Nova Scotia, let alone such ambitious projects as cross cutting a large district with a tunnel. With the existing prejudice among foreign capitalists against Nova Scotian gold mines such ambitions lead to a waste of time that is ruinous.

A most harmful theory, founded on a few exceptions, is that even if a lead shows no surface values deep sinking will strike richer ore. The metals they say are leached out of the surface ores. If so where has the gold gone, how was it leached out, where is it now, what form is it in, and finally how can it be proved that there was formerly any more gold to leach out than there is now? Where is the evidence? Mere opinion even from the "old and experienced" does not count, We want evidence. As a scheme for making

a job last it cannot be beaten. It has been worked for all it was worth in Cobalt and elsewhere, and hundreds have been ruined where one has made a fortune through the custom. Over the whole continent wherever metal mining has been carried on are countless thousands of holes capitalized from $50.000 to $1.-000.000 that were sunk on this theory. It seems strange that no matter how far glacial erosion has been carried whether 100 or 10,000 ft there are in every mining region men who advise and men who believe that 100 200 or 500 ft deeper as the case may be, they will or may strike it rich. The habit was strong in Nova Scotia 20 to 30 years ago and many old pits show the folly. The leaching out and replacing of ore is well known to be common and metals other than gold are usually subject to the process, But the theory has proved so well suited to making a job last or coaxing money out of the gullible that its application has become universal.

There are places and conditions under which deep sinking and rock tunnels may be advisable. One is the cutting of leads beneath streams and lakes but even here there should be good evidence that pay ore exists to repay the greater cost of reaching it. Another place where deep sinking is necessary is in the crowns of anticlines where only a deep shaft can cut the underlying leads. A diamond drill hole would be a cheaper method of proving the ground, but either would cost more than surface prospecting in surface of average depth. In either case the position and dip of paystreaks should be 'a reasonable chance of striking pay ore in a deep shaft or drill hole. No expensive jobs like these should be undertaken without some definite aim in view unless the investors wish to take a gamblers chance,

It would be safe to say that 9 out of 10 prospecting shafts and tunnels have been failures, and the embittered investors have refused after that to invest in even the far smaller cost of surface prospecting. This probable loss of capital must be considered when deep prospecting shafts are proposed and they are sunk without regard to the dip of paystreaks or the existence of rich spots. Witness the deep shaft on Dolliver Mountain, which however promising, is now idle. This last fact, and others like it, are what prejudices are formed on and by which capital is turned aside.

In prospecting beneath ground for extensions of known veins a little knowledge of practical geology is often of great value.

I recall two cases where close observation may have prevented the closing down of a mine. In the

Stemshorn Mine at Mooseland the eastern ends of the leads are cut off by a break dipping east at an angle of about 50 degrees and running N 70° W. It is probable that the granite 1-2 mile to the south-west having once been in a molten state, shrunk, faulting the anticline as seen on the 96 ft. level of the Stemshorn Mine. As the opening widened, the overhanging eastern wall of the break settled down on the western part, thus opposing higher belts on the east.rn side to lower belts on the western side, the result being that now the fold on the east has a decided pitch to the west.

About 1893 a tunnel was driven across the break in search of the eastern extension of a lead on the western side. It was a failure and a thousand dollars were wasted because the man in charge could not or would not understand that there was such a thing as practical geology.

Another case was the failure to find the continuation of the Bonanza or Kings Lead at Brookfield, Queens Co, N. S. After spending several thousand dollars no one knew anything that wonld give an idea which way the lead was thrown on the east side of the break, whether it was up, down, or sidewise. No plans were kept, no details recorded, and except in a general way no information of an[illegible] value is obtainable.

Again I should impress upon all, even those who know it all, the importance of keeping plans and re-cc[illegible] details. It takes s genius to remember all th[illegible]s of even one business.

[illegible] most business-like kind of underground pro[illegible]pecting is the starting of a cross tunnel from a profitable mine, across a belt of leads in a zone known to be gold bearing. Here the chances are in our favor especially if the leads sought for are known to carry pay ore on the surface. This policy may perhaps show a want of enterprise to some and, to err on the side of caution. There are however a large number of chances of this kind that still remain unthought of, so until these jobs are finished there is little room to talk of want of enterprise in more dangerous lines And I would suggest that those who complain of this want of enterprise in larger and more dangerous ventures themselves start the ball rolling by raising money for the smaller and safer ventures first.

CHAPTER XXI.

The Core Drill in Prospecting.

Through the enterprise of the Provincial Government core drills run by steam and hand power are now being used in prospecting in Nova Scotia. These are seven in number as follows--

No I. A Calyx steam drill with a capacity of 1000 ft.
No 2. A Diamond Steam drill, capacity 800 ft.
No 3. A Diamond hand power drill, capacity 350 ft.
No 4. A Diamond hand power drill, capacity 350 ft.
No 5. A Calyx steam drill, capacity 1000 ft.
No 6. A Calyx steam drill, capacity 3000 ft,
No 7. A Calyx steam drill, capacity 350 ft.

In the Calyx, shot is used instead of diamonds. These drills are loaned by the Government to private individuals and companies who pay the cost of transporting and operating.

These drills have been used principally in prospecting for coal and iron; their use in the gold mines has so far been very limited. They have been used at Isaac's Harbor, Waverly and Caribou, but though increasing our knowledge of the structure of the gold bearing anticlines, the benefits from a financial point of view have not been great. New leads have been discovered by their use but the paystreaks, if any there were, have, as might be expected, been missed.

At the Caledonia Mine, Molega, a 220 ft hole was put in horizontally from one of the lower levels. But the leads were cut while no pay ore was discovered. The cost of this hole was greater than that of 1500 ft of trenching in the surface above.

At Waverley, a drill hole on the northern side of the Barrell Lead showed the presence of a series of leads above it but missed the pay ore they were searching for.

At Dolliver Mountain a vertical drill hole showed the presence of underlying saddle veins but nothing of great value.

Owing to the uncertainty of the pitch of paystreaks or the distribution of good spots in the veins the chances for striking these with a diamond drill is equal to the chance of striking a rabbit in a thicket by firing a bullet at random into it. It is at best a rather uncertain method of prospecting for gold though it is well

suited for locating coal seams. The drill may not miss the lead but unless located on a known zone of leads containing pay ore the results will be disappointing. As an experiment for a man of weak finances it is not to be advised. There are lots of easier jobs. If the small capitalist wishes to invest in a surer thing let him follow up a line of rich drift on the surface to its source, which is known at least to lie within certain limits much easier and less costly to get at.

The core drill however has its uses in gold districts and one of the chief uses is in the piercing of anticlines where they form domes of considerable width. Here where the saddle veins overlie each other they find their special field, as deep shafts are rather too expensive for prospecting purposes. But even here they should only be used where a zone of paystreaks are known and the drill can if possible be driven through their extensions; unless the hole is made merely to investigate the structure, There is therefore this difference between the core drill in deep mines and surface prospecting, In the first case you take your chances, in the last you are after something that you know exists.

Another use for the core drill is the piercing of the rocks above hidden anticlines that show indications of being gold bearing. Beneath the limestone and other Carboniferous rocks of Middle Musquodoboit there is a fold near which gold bearing sands have been found. A hole 300 ft deep should reach the whin and slate there. Other localities where the same conditions prevail are Little Nine Mile River, McKays Settlement and Three Mile Plains, in Hants County, and Gays River in Colchester County.

Of course these are only gambles as much so as vertical shafts with chances for striking pay ore at a small cost just as much against the investor. The chances are however there and if a man can afford to lose he may gain by such a venture.

Another and more useful purpose can be served by the drill as an aid to surface work in cutting ground it is impossible to reach except by a rock tunnel. When the line of drift is crossed by a swamp or a stream and surface work made impossible the drill can be set up and the work done cheaper than in any other way.

A few items as to the cost of running these drills may be useful to prospectors who may wish to add the drill to their outfit for the purpose of cutting the rock beneath swamps or streams.

The No. 1 Calyx, a steam drill capable of boring 1000 ft. has been used often with satisfaction. The cost per ft. for 5349 ft. was $1.46 ft. Of the total cost, 77 per cent was labor and management, 13 per cent

fuel and 4 per cent shot and gravel. The number of holes was 9, averaging about 594 ft each.

Another Calyx, No. 5, like No. 1, averaged $1.20 1-2 cents per ft. for 1327 ft.

No. 2, a Diamond drill, steam driven, with a capacity of 800 ft. averaged 83 1-2 cts. per ft. There were 11 holes averaging about 435 feet each. The labor percentage was 73 1-2. Fuel and diamonds 10 p.c. each.

No. 7, a small Calyx drill, of 350 ft. capacity, averaged $1.27 for 245 ft.

The record for the year 1911 was as follows;—

No. 1 drill, 2732 ft., 6 holes from 132 to 605 ft., cost per ft. $1.44. Labor and management 80 per cent. Diamonds 7 1-2 per cent. The lowest average rate of boring was 8 inches per hour, the highest 13 1-2 inches. This drill is here styled a steam Diamond, though No. 1 was formerly a Calyx.

No. 2 drill, Diamond, started a few holes in Moose River Mines only boring a total of 41 ft. 8 inches.

No. 5 drill, a steam Calyx, producing a 6 inch core, bored 1327 ft., costing $1.21 cents per ft. The labor and management percentage of the cost was 53 1-2 per cent. Fuel 22 per cent. Shot etc. 4 per cent. The average speed was a little over 1 ft. per hour, but the greatest speed reached 6 ft. 7 inches per hour.

No. 7 drill, a Calyx, 1 3-4 inch, hand power, bored 3 holes totalling 308 ft. costing $1.42 1-2 per ft. Labor and management 86 per cent. Shot totaled only $3.50, while freight cost $46.40 cents.

It will be seen that there is not much difference in the cost per foot, between the work done by the Calyx and Diamond drills. What difference there is, is in favor of the diamond drills. The cost of the work is just low enough to make it doubtful whether it could replace the pick and shovel in deep surface. However if the cost in all gold mining districts were kept down as low as in Caribou there would be no doubt of the usefulness of the drill even in surface prospecting. These, seven holes varying from 140 to 751 ft. in depth, altogether 2306 ft., cost 54 1-2 cents per ft. Cost of labor and management 64 per cent. Fuel 18 per cent, Diamonds 13 per cent. The rock bored through was chiefly slate, accounting partly for the small cost. The fastest rate of boring was 5 ft. per hour, while the highest average was 2 ft. per hour. The lowest average was 1 1-2 ft. per hour. Nothing of value was found because the drillers were after no particular pay-streak nor following any particular line of rich drift.

Boring in quartzite would have cost more, but it is evident that it would be economy to use the diamond drill in slate when the surface became deep.

Chapter XXII.

Some Hidden Bonanzas.

Though gold mining in Nova Scotia is now in a very discouraging condition there is abundant evidence of wealth scattered over the country. This, in the shape of rich but hidden veins buried deep beneath hills of glacial drift is no mere dream or an idea dependent on a prospector's imagination. It is a fact proved by the presence of the numerous rich gold bearing boulders found all over the southern part of the province for 50 years past. That these came from a vein of like ore in the neighborhood is undoubted by the best authorities.

The history of these deposits of rich boulders, as far as known, is as follows—Previous to the last advance of the northern ice sheet these rich leads were exposed to frost and sun and shattered by its repeated contraction and expansions. Then with the advance of the ice the loose material was torn away from the bedrock, ground up and the resulting boulder clay, with the rich quartz, carried away in a southerly direction. In some cases it was carried several miles, as to the south of Montague Mines. At other places the ice left long and regular trains of rich quartz, as that leading up to the Vermillion Lead at Gold River. Numerous rich leads have been been found in other districts by following up these lines of drift to the leads it came from. The evidence is so strong that there is not the least doubt that each deposit or train of rich boulders means the existence of a rich lead near by.

Many of these rich leads still remain undiscovered, chiefly through want of enterprise of the moneyed men of Nova Scotia. It has been said that $1,000,000 of Nova Scotian money has been invested in Mexico. Had we one tenth of that amount spent in judicious and economical prospecting in Nova Scotia I have no doubt that a score of mines would be yielding their profits today. Forty or fifty valuable prosperties are idle to day because the owners are unable to prospect them for want of funds, but there is hardly a case in which arrangements cannot be made to do the work on shares.

These known but undiscovered leads must number nearly 100 and furnish a reserve of wealth on which to draw on in the future.

The most common objection to prospecting in Nova Scotia is that there is such a danger of failure to find the lead. This danger is of course always present when prospecting is begun without plans, without a

knowledge of the structure of the district worked in, or the direction and nature of the drift transportation. And even when this is fairly well understood there is usually a want of fuuds which stops effectually all continuous search for these hidden veins.

Nova Scotia with her narrow but rich paystreaks will amply repay any intelligent young man for devoting a few years to solving the problems in glacial geology which are continually baffling the prospector. To do this he must be provided with funds, for it is needless to say that no prospector can go far in work of this kind without financial help. There is work in Nova Scotia for a corps of well trained prospectors, and there is wealth enough in our gold mines to pay for their education. But all depends on whether prospecting for gold will ever be considered by our wise ones as a subject suitable for our technical classes. If we could only inflate it with dignity by the addition of Latin, Algebra, Geometry, etc., it should at least merit consideration.

The following is a list of some of the prizes yet to be won by the prospector in Nova Scotia, and the values where given show that they are well worth a special training.

District and Lead	Size of Lead	Value
Fifteen Mile Brook, Queens Co. ....Hall Lead	5 to 10 in.	Very rich
" " " ....Shaw Lead	9 to 15 in.	1 to 3 ozs
" " "	1 to 1½ ft.	Rich
Broad River, " .... Cross Lead	?	"
Mill Village, " ....Prest Lead	10 to 1[illegible] in.	2 to 3 ozs
" " .... "	1 to 2 ft.	1 oz
West Caledonia, " ....Freeman Lead	Over 1 ft.	Several ozs
Centre, Lunenburg Co..............................	2 ft.	2 to 3 ozs
Somerset, "	7 in.	2 ozs
Gold River " .... Touquoy Lead	8 to 18 in.	2 to 10 ozs
" " ....Mill Lead	?	Very rich
Rawdon, Hants Co..............................	8 to 12 in.	10 ozs
Ardoise, "	?	Very good
McKay's Settlement "	?	"
Renfrew, " ... .Several Leads	5 to 16 in.	Rich
Little Nine Mile River, "	?	Good
West Chezzetcook, Halifax Co..............................	3 to 16 in.	8 to 10 ozs
Gold Lake, "	Very large	Good
" " ....Bunker Lead	?	Rich
Mooseland, Cars Hill " ......Jim Hilchey Lead	3 in. & over	500 ozs
" " " Isaac Hilchey, Area 517	?	Several ozs
" " " ...Stemshorn, Area 583	10 to 14 in.	Up to 14ozs
" (North) "	1½ to 2 ft.	1 oz & over
" " "	Small	Very rich
Beaver Dam, " .... Gladwin Lead	?	"
Killag, " ....Red Lead	6 to 8 in.	2 to 3 ozs
" " .... Striped Lead	10 in.	Good
" "	16 in.	7 ozs
" "	2 ft.	Up to 3 ozs

District and Lead	Size of Lead	Value
Montague, West, Halifax Co	?	Good
Killag, Halifax Co.......................... Horn Lead	9 in.	1 to 2 ozs
Ecum Secum, "	?	Rich
Fifteen Mile Stream Rd, Halifax Co...... Indian Road	5 to 8 in.	Very rich
" " Mines, " ......Williams, &c	?	1 to 2 ozs
Gegogan, Guysboro Co... ....2 Seams	?	Very rich
Queensport, "	?	Rich
Liscomb River " .....Above Devil's Eddy		"
Upper Seal Har. Lake " ... East Gold Brk areas	35 in.	"
" " " ...H. Richardson areas	12 in.	"
East Isaac's Harbor, " .... Sand Cove		"
Leipsigate North, Lunenburg Co ....Ernst Lead		"

District, Lead or Location	Width	Value
East Isaac's Har, Guysboro Co,... Area 619, Block 2	?	Rich
" " " ... " 432, "	?	"
" " " Area 1733, Original Block	?	"
" " " " 1995, "	?	"
Stillwater "	?	"
Hd. of Indian Hr. Lake "	?	"
Harrigan Cove, Halifax Co. ....Area 50	?	"
" " .... " 279	?	"
Mooseland, E. of River " .... " 706	?	Good
Fifteen Mile Stream, " ....Hudson Mine	?	Rich
South Uniacke, " ....Area 293	?	"
Caribou, " ...Area 271, Block 1	?	"
" " ... " 694, " 4	?	"
Goldenville, Guysboro Co............ " 699, " 3	?	Very rich
" " .... " 790, " 3	?	Rich
" " .... " 731, " 4	?	"
Up. Moser's River, Halifax Co. .... Wilson's Fall	?	"
Necum Teuch Ar. " .... West Side	?	Good
Wine Harbor, Guysboro Co .... Area 11, Block 1	7 in.	Rich
Fish Hawk Nest Riv. Halifax Co....3 miles S. of Goffs	?	Good
Head of Chezzetcook, " . ... West Side	10 in.	Rich
Rawdon-Beaver Bank Rd. " .....W. of Wallace's	?	"
Rocky Brook, " Shubenacadie Lake	6 to 10 ft.	"
Brookfield, Queens Co..................Area 90, Block 2	?	"
Molega, " .... " 662, " 5	9 in.	Very rich
" " .... " 958, " 5	?	Rich
" " ....Desmond Lead	7 in.	Rich
Little Liscomb Lake, Guysboro Co..................	?	Good
Lindsay Lake, Halifax Co	12 in.	Rich
Little S. W. River " ....Union Dam	?	Good
Grant River, " ...... Cameron Dam	?	"
Ragged Falls, " .....On 12 Mile Stream	?	"
Como Lake, " ......On 7 "	?	"
Dayspring Lake, " .. .. On 17 "	?	"
Carleton, Yarmouth Co............	8 in.	Rich
Kemptville, "	1 to 2 ft.	"
Gold River, Lunenburg Co....... .... Swamp Angel	1 to 1½ ft.	Very rich
Lake Catcha, Halifax Co ....Water Hole Lead		"
" " ....Areas 182 and 223	3 in. and ?	Rich

Besides the above 84 or 85 good leads that still remain hidden there are others, especially along pay zones of the more important districts. Where two leads throw quartz much alike it is hard to distinguish them, so all the boulders are classed as belonging to one lead.

In the conservation of natural resources in Nova Scotia nature is doing her duty to the coming generations. These hidden leads await the coming of the trained prospector, who in turn awaits the coming of the man with enterprise and money.

No amount of toil can make up for the want of a thorough knowledge of the structure of our gold districts and their surface deposits. But no amouut of geological knowledge will ever find a hidden lead without a solid backing of money and muscle.

CHAPTER XXIII

Problems in Prospecting.

Inseparable from prospecting in Nova Scotia is the necessity of being able to explain some of the numerous problems in glacial and structural geology which are continually coming before the prospector. They oppose him at every turn, and unless he has a particular fitness for the study of nature's lessons fate usually marks him for a failure. Having no capital it is little use to talk to him about the employment of a specialist. Some of these problems are quite simple while others tax the knowledge of the geologists.

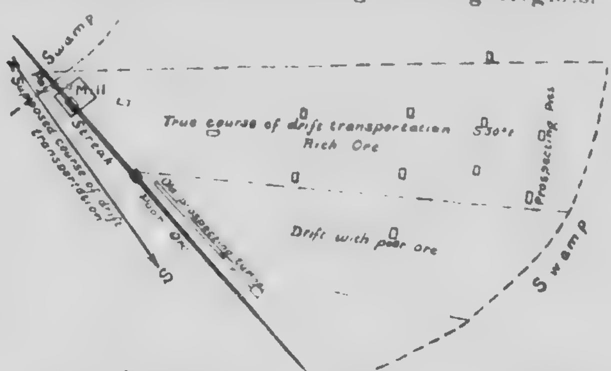


Fig 40. Problem No 1. Plan of Prospecting at Blockhouse, NS

The above is a sample of one of the many riddles a prospector is expected to solve. For many years beginning about 1884 rich gold bearing quartz had been picked up at Blockhouse. It was a dark seamy quartz from a large vein, and because it contained dark seams it was pronounced bedded lead quartz.

From then until 1896, nearly every summer, search was made for the vein from which the rich quartz came. Some old prospectors finally decided that there were two leads a light colored vein of poor ore and a dark seamy vein of rich ore.

So the work was carried on year after year on three wrong ideas—viz—1st. That the rich vein was a main lead running east and west. 2nd. That there were two leads. 3rd. That the course of transportation was to the south. A number of prospectors tried their various theories on the work but all worked on the one idea "go north" and none had anything but a faint idea that it could be a cross lead. Several

old and experienced prospectors recorded their failures and gave it up. The last prospector came the nearest to finding it as he ran a long trench and tunnel on the "go north" idea paralle. with the rich lead and only 4 ft. from it.

I examined the ground and its neighborhood in 1894 and came to the conclusion that the lead was a fissure or cross lead running north and south, and that the course of drift transportation was to the south-east instead of south. Not having seen much of the drift ore I thought that there might have been two leads.

In 1896 I was asked to take charge of the prospecting and started the pits described in Fig 40 as above. This work was begun on Jan. 14th in the depth of winter and in 14 days we had tracked the rich quartz to its starting point near the present site of the mill, 11 years after the first work was done in the search. It was a surprise to discover after a while that all the gold bearing quartz light, dark, seamed or otherwise came from one vein.

I have no idea that failure would have attended the efforts of former searchers had they not that supreme contempt for all geological teachings that was accounted a mark of piety in the days when science and religion was thought to conflict with each other. In the eyes of these moss grown prospectors the geologists in world building was what the anarchist is in politics, so the teaching of structural and glacial geology were wasted on him.

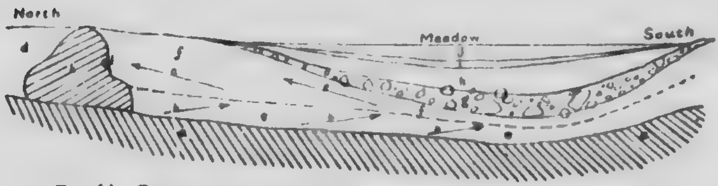


Fig 41. Problem No 2 Section of drift at West Caledonia Showing reversed drift transportation

Showing reversed drift transportation at West Caledonia, N. S.

a. Section of bedrock along gold bearing vein.

b. Arrows showing direction of rich drift transportation during the Glacial Age.

c. Arrows showing course of drift reversed by a stream from the southwest in later ages.

d. Undisturbed drift without gold.

e. Undisturbed drift with gold.

f. Drift with gold removed by stream from e and re-deposited in a new position.

g. Barren sand, gravel, and boulders from a higher level up the stream.

h. Quicksand without gold from upstream.

The following is a surface plan of the West Caledonia problem showing the lead given in Fig 41, and the boulder, k, against which the gold bearing quartz l, was lodged.

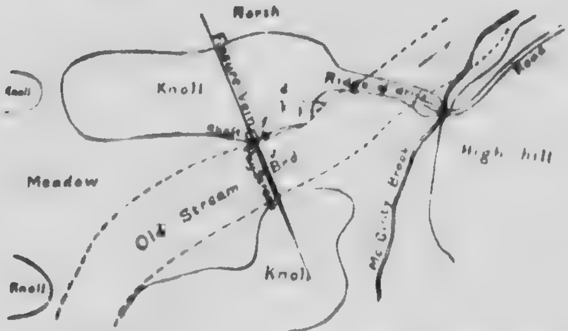


Fig 42 Problem No 2. Surface Plan at West Caledonia.

i. Fragments of leaves, wood, waterplants and shells.

j. Peat and swamp muck.

k. Large boulder 40 feet long and 12 ft. wide.

l. Gold bearing quartz wedged in a crack in the south side of the boulder.

The surface here shows a gentle ascent to the south with a small stream running north 100 yards east of the lead.

The true explanation of this arrangement of deposits seems to be the following. The loose material and gold from the vein and the surrounding rocks was first pushed to the south by the great ice sheet during its last advance. Then after the retirement of the ice the gold bearing drift was cut away near its source by a stream flowing from the south-west. This stream removed a large part of the drift to the north-east, to f.f., wedging a gold bearing boulder, l, into a crack in the south side of the large boulder, k. After a time the debris formed a dam about 100 yards below which still remains. While this was going on the stream became filled with boulders, gravel, and sand from further up, but after a pond was formed sand alone was transported forming the quicksand, h. Then it appears that the brook was turned into its present channel and the old stream remained a quiet pond in which was deposited leaves, sticks, waterplants, and shells. Finally swamp muck and peat, j, filled the pond level with its banks and grass and trees spread over it.

From 1886 to 1902 all the prospecting was done under the impression that the gold bearing drift all came from the north.

About 1902 a piece of gold bearing quartz was found jammed into a rack in the south side of a large boulder or ledge. As this piece of ore could not have been thrust in from the north I was convinced that this portion of the gold bearing drift came from the south. Following up this new idea in 1905 the vein searched for, a well defined fissure, was found about 100 ft to the south west. The richest part of the vein is known to lie beneath the quicksand and muck of the meadow as the richest drift has been found along its edge.

This valuable find like many others awaits capital for its further development.

This is from Gold River, near the Touquoy Bog, where prospecting has been carried on since 1863 or 1864 without success. It is but one of the many problems in the west end of the district, most of which are yet unsolved owing to the complicated nature of the much disturbed drift common there.

a. Deposit of coarse sand and gravel with gold bearing quartz much waterworn, with a current of water running through it to low land further east. It was evidently the bed of a brook running over a rich vein further west.

b. Unstratified drift of quartzite, sand, and clay.

c. Stratified drift of gravel, sand, and clay and a little gold bearing quartz.

d. Unstratified drift of same nature as b.

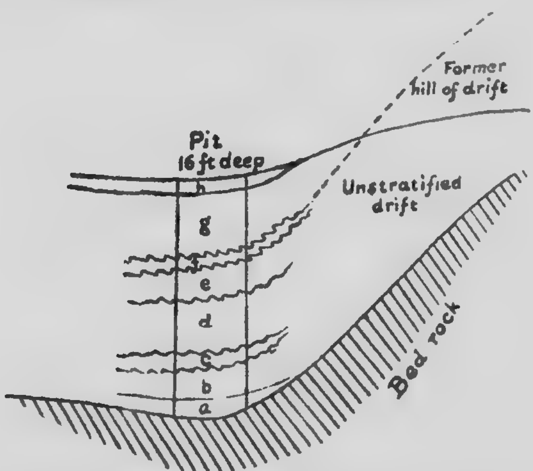


Fig 43. Problem No 3. Section of drift.

Showing drift modified by the action of water not far from a gold bearing lead.

e. Stratified drift with sand and clay in its upper part.

f. Fine dark clay with pine and spruce cones, beech-nuts, various seeds, leaves, and birch bark. Also the remains of water plants, and water bugs. The whole was crumpled into small folds.

g. Unstratified drift.

h. Stratified drift chiefly granite gravel and sand.

This shaft showed gold in the bottom layer a, while the unstratified drift that lay on it contained none, and very little was found in the next stratified layer c.

Under ordinary conditions the prospector would search to the north for the source of gold. But in the face of the unusual co. ditions shown in the section it was evident that here was a problem needing investigation. Without detailing the various steps in this investigation I will give the conclusions arrived at. The surface conditions were, a high bluff of glacial drift to the south, a lower one to the north, a miry bog the site of a former lake, to the east, and a slight ascent up a small valley to the west down which flowed a small brook. West of the section shown in Fig 43, about 250 or 300 ft, was a gold bearing lead still undiscovered.

The brook running over or near the vein carried down the loosened quartz, gold, clay, sand and gravel depositing the coarsest material and forming layer a. but carrying the fine material into the lake below, Undermining the bluff to the south it caused a fall of the earth forming layer b. The upper part of this layer being worked over and stratified by the water formed bed c. Only a little gold was deposited in this layer probably owing to the lessened strength of the current. Then came another fall of earth, layer d, and the upper part being worked and mixed with fine clay brought down by the now slowly flowing stream formed layer e. This in its later stages. seem to have completely stopped the stream and formed a pond which found an outlet to the west. This was apparently followed by a period of quiet during which a forest grew and grass, flags, and other water plants filled the pond. Water bugs crawled, cones, nuts, twigs, and leaves fell and were buried and black mud collected on the shore. The presences of beech nuts here lead to the discovery of a former brook flowing from a former lake a half a mile to the south. This lake is now a miry bog with a hill on its western side, the only place in the neighborhood where beech trees can be found. The brook leading from this lake is now filled with sand carrying gold, the source of which has not yet been found.

After a long and quiet period the whole bluff to the south gradually slid down the slanting surface of the ice planed rock, crumpling the muddy pond border. Then it snddenly gave way burying the shore line with its vegetation beneath four or five ft of unstratified drift, forming layer g. Then followed a slow surface wash from the hills on both sides forming layer h. As this shows signs of stratification the water to work it over must have come from the west showing that the western outlet must have been again stopped. Evidence for this is seen in the muck filled bed of a small pond on a level with this layer, but 100 ft to the west.

Here is an example in which a moderate knowledge of glacial geology is of great importance. Here was gathered together drift material from different sources, transported from different directions, and under different conditions. The source of the rich float would under ordinary conditions have been searched for to the north, whereas it came from the west.

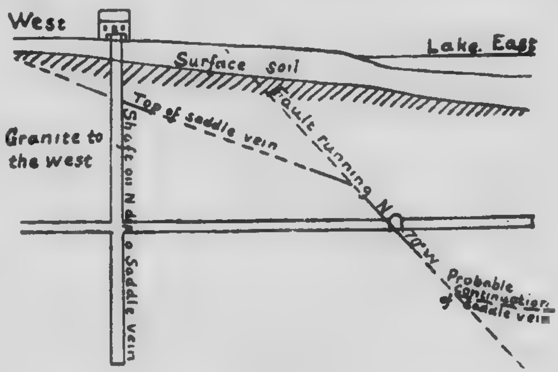


Fig 44. Problem No 4. Section along saddle. at Mooseland.

Showing prospecting tunnel in the Stemshorn Mine, Mooseland.

The above sketch shows fairly well a problem that cost the Mooseland Gold Mining Company much money and disappointment. Their prospectors despised all reference to anything pertaining to geology and did not examine the country around them for clues to the structure of the district, and the result was failure. They drove a tunnel across the fault to search for the continuation of the saddle vein. Not finding it, they turned to the north with the same result, for the simple reason that the continuation of the vein was perhaps 100 ft. below them.

All the evidence available points to the following as the true explanation of the problem. On the supposition that the granite is the result of the melting of the whin and slate of the gold series, it went through a cooling and shrinking process. This shrinkage drew the Mooseland anticline to the south, faulting the rock at a weak point near the large cross country fault in the river near by. This shrinkage left an opening into which the overhanging eastern side of the fault settled, thus bringing higher beds on the eastern side in contact with lower beds on the western side. Neither the vertical nor the horizontal displacement is yet known, though two other faults 100 yards further west have moved the anticline south 560 ft.

Objectors to this theory say that if the eastern end of the fold fell or settled into an opening caused by shrinkage, then that end should pitch west instead of east as the west end does. It does pitch west. They say also that if the fault was caused by shrinkage of the granite then the fault should be parallel to the granite. It is parallel to the granite

A little time spent in an examination of the structure of this district would have convinced the operators that the venture was but a gamble. They would have stood a better chance of success by driving their tunnel along the fault so that leads on both sides of it would have been intersected. Much rich drift on the lake shore directly over the tunnel shows that there was possibility of striking a good lead near by, had that programme been carried out.

Problems in Prospecting, No. 5.

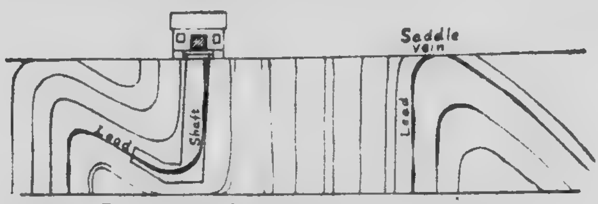


Fig 45. Problem No 5. Section across saddle veins, Showing Shaft on double topped anticlinal at Fifteen Mile Stream

Fig. 45 shows one of the worst blunders I have yet seen in Nova Scotia. A main working shaft was put down on a lead without a previous examination of the structure of the district. Even when the publication of the Government maps gave to the public the needed information respecting the formation of this fold, the knowledge was slighted. The operators were surprised when the vein came to an end, as they thought,

at a slight depth. A few minutes examination of the Government plans would have prevented both disappointment and loss of money. Properly kept underground plans of past operations should also have enabled them to avoid such mistakes. Again I would repeat my advice on the necessity of a thorough knowledge of the structure of each district worked in. We are too prone to appoint as manager or foreman of a new mining enterprise some specimen noted for breadth of body rather than breadth of mind. While these splendid specimens of manhood with their muscle and commanding presence may be well fitted to rush work below ground, it needs the careful, plodding, studious man to lay the plans that mean success. Too often, the word of the big man, the influential man, or the fluent talker, carries weight on questions pertaining to mining where the thorough knowledge of the man who works hard and studies hard is slighted. Without a special course of instruction, such as is given in other trades in the Technical School, it will probably always be as it is. I will refer to this again.

Many more of these examples might be given, but the foregoing will be enough to show the absolute necessity to a prospector of a thorough local knowledge of the district he is working in. Added to this, should be a knowledge of the principles of glacial and structural geology. In fact, this last should be but the foundation on which the more practical local knowledge should be laid.

The few examples given show the great variety of problems facing the prospector in Nova Scotia. Not only must he be a man of great resource and skill in the manual labor necessary, where money is doled out so sparingly as it is in Nova Scotia, but he must be an adept in the solving of riddles in structural and glacial geology. With a proper training on the lines suggested above I believe we would hear of fewer failures in prospecting.

CHAPTER XXIV.

Working Costs.

The cost of prospecting is in Nova Scotia a very important part of the subject. It is no uncommon thing in Cobalt and the West to devote $10,000 to $20,-000 to prospecting. Here prospectors are often expected to show as good results with an expenditure of $500 to $1000. I have seen lumbermen with 6 months experience in silver mining at Cobalt offered $100 per month and a quarter interest to wander through the woods scraping moss from the rocks. In Nova Scotia a man of life long experience and intelligence is expected to take charge of workers for $60.00 to $75.00 per month.

To say the least, the treatment meted out to Nova Scotian prospectors for solving riddles that experts often fail in is both unjust and ridiculous. There has so far been no reward for a thorough mastery of the business, so never, except in very few instances, has any attempt been made to study thoroughly the facts of structural and Glacial Geology as bearing on prospecting in Nova Scotia. The sums of money voted by companies and individuals in Nova Scotia if voted at all have been so ridiculously small as to excite the contempt of foreign investors, and confirm them in the belief that our mines not worth their attention. Therefore it is to our moneyed men, those who have thrown away their thousands in foreign mining stocks, that the blame for the present condition of gold mining may be laid.

The high costs of prospecting and mine development carried on by foreign mining engineers and mining men as compared with the work done by local men is seen and acknowledged. "High priced men pay best," is a phrase learned by our small investor to his sorrow. Probably they mean high grade men but are not able to distinguish one from the other. Therefore any dignified looking individual from the land of liberty and baked beans, can when unknown, pose as a high priced man and become an authority on how mining should be done in Nova Scotia.

The history of the London Gold and Silver Development Company, is an example that many of these traducers of Nova Scotian skill and intelligence will remember to their sorrow.

In the search for and development of home and

foreign mining properties Nova Scotian foreman have proved both effective and economical. They hold the record in Cobalt for speedy work, and usually our miners take first place in the drilling matches.

On the question of costs I may give some information from my own experience that may be useful to beginners. It is in tabular form; selected pits of various depths, dug under various conditions and at various times. They have been collected from the records of about 28 years and have been grouped as well as possible to show the cost of working under the conditions here named. The depths are given but the width and length varied so little that it is not set down but understood to average 7 ft. by 4 ft. The wages are calculated at $1.25 per day, which is lower than the average today. The principal idea in this question is how much can a man do in a day. This I try to answer here.

No. of Pits	Depth	Mixed earth and sand	Sand above Till below	Till (Clay and rocks)	Dry	Fairly dry	Wet	Very wet	Extremely wet	Cribbed	Windlass	Windlass and Pump	Cubic ft. dug per day	Cubic ft. in each pit	Total cost of each pit at $1.25 per day	Total cost of each pit at $1.75 per day	Days work in each pit
15	5 to 12			"		" to	" to	"					51.2				
11	5 to 12		"				"						57.				
4	6			"			"						44.	168	$ 4 77½	$ 6 68½	3.82
2	6		"			"							73.	168	2 86½	4 02½	2.30
3	6			"		"							51.4	168	4 09	5 72	3.27
1	6	"			"								236.	168	89	1 24	.71
4	7			"			"						37.1	196	6 62½	9 27½	5.30
2	7			"				"					29.5	196	8 30	11 62	6.64
3	8		"	"			"						55.5	224	5 05	7 07	4.04
2	8		"			"							50.1	224	5 59	7 82	4.47
1	8	"			"								292.	224	87½	1 22½	.70
3	9		"					"					23.9	252	13 19	18 46	10.55
3	9		"				"						36 5	252	8 72	12 21½	6.98
5	9			"			"						39.	252	8 07½	11 50½	6.46
2	10			"			"						44.	280	7 95	11 [illegible]	6.36
2	10			"		"							71.	280	4 92½	6 89½	3.94½
1	11	"			"	—to—	"			"	"		36.5	308	10 55	14 77	8.44
4	11			"			"				"		26.5	308	14 06	19 [illegible]	11.25
2	12			"				"			"	"	28.	336	15 00	21 [illegible]	12.00
2	12		"					"		"	"	"	30.8	336	13 64	19 09	10.91
2	13		"		"	— to	—	"		"	"	"	34.	364	13 39	18 74	10.71
1	14		"		"	——	to	——	"	"	"	"	22.5	392	21 77½	30 48½	17.42
3	15			"			"			"	"	"	32.9	420	15 96	22 35	12.77

No. of Pits	Depth	Mixed earth and sand	Sand above Till below	Till (Clay and rocks)	Dry	Fairly dry	Wet	Very Wet	Extremely et	Cribbed	Windlass	Windlass and Pump	Cubic ft. dug per day	Cubic ft. in each pit	Days work in each pit	Total cost of each pit at $1.25 per day	Total cost of each pit at $1.15 per day
2	16		"		"	—to—	"			"	"		41.	448	10 90	$13 62½	$19 07½
4	17			"	"					"	"		36.	476	13.22	16 52½	23 13½
2	17		"				" to	"		"	"	"	30	476	15.87	19 84	27 77
2	18			"		"				"	"		44 4	504	11.35	14 18	19 86
3	18			"	" to	"				"	"		82.	504	6.95	8 69	12 16
2	19			"			" to	"		"	"	"	25.8	532	20.62	25 77½	36 08½
1	20			"		"				"	"		27.	560	20.74	25 92½	36 29½
2	22		"				" to	"		"	"	"	20.6	588	28.16	35 20	49 28
1	23		"			"				"	"		46.	616	13.39	16 74	23 43

The cost of sinking here is a calculation based on the number of ft. done each day of 10 hours. This, while not exectly correct, comes very near the actual time and cost and saves a long re examination of blurred notes reaching back many years.

In shallow trenches dug through all kinds of soil a fair average cost is not easy to strike, as conditions vary so much. However, in 42 trenches from 2 to 5 ft. deep in all kinds of ground and under all kinds of conditions the speed averaged 95 cubic ft. per day of 10 hours each. 16 other trenches from 5 to 12 ft. deep under same conditions averaged 66.8 ft. per day of 10 hours.

A second column of costs at $1.75 per day is added to give the operator an idea of the cost of the work at the highest wages paid to-day.

CHAPTER XXV

Useful Items.

Tempering—Heat to a cherry red, hen rub with soap. Then heat again and dip in clear cold water. The soap prevents scale from forming and does away with the need of polishing to see the colors.

To temper a pick—Put the body of the tool in the fire and leave the point cut. When the body is red, heat the point to a dull red. Hammer edgewise first and flatwise afterwards, then file ends a little. Heat to dull red again and cool in rain water with the chill taken off to about ¼ inch from the end. Temper to a dull blue. If too brittle carry color a little further. Then cool all over Work at as low a heat as possible and do not burn the steel. Once it is made white hot it is spoiled.

To renew burnt Steel—

Heat several times to a dull red cooling each time in hot water.

or melt together, mutton fat 10 parts, Linseed oil 10 parts, Lamp black 1 part. Then heat steel and dip in mixture for 1 minute.

or Melt together Rosin 10 parts, Mutton fat 3 parts, Fish oil 5 pa s. Heat steel to a dark red and dip in mixture for ½ a minute.

Drill—Temper—

For hard rock temper from light ye ow to straw color. Too light will be too hard. Darker than straw color too soft.

To Weld Steel—

Welding compound, 1 part Salmmoniac, 1 part Borax and a pinch of Alum. Grind together and melt until clear. Pour out, cool, and grind up for future use.

Economy hints—

One of the many makeshifts in prospecting is the se of small crotched sticks for windlass stands. They are cut off a foot longer than the height of the windlass and spiked to the timbers the deck rests on.

Small poles for a deck saves the carriage of lumber.

Often the non-arrival of roofing for a camp makes it necessary to get a substitute. In the spring and early summer spruce and fir trees readily yield their bark for this purpose. The spruce bark is tougher

and less full, as a rule, of small knot holes. To get it, cut the bark around the tree near the ground. Then cut it as high as you can reach with an axe in an zig zag manner, a cut slanting to the right overlapping one slanting to the left, until the cut is complete around the tree. Then with a wide wedge shaped piece of wood gently pry off the bark. These overlapped on roof make a good substitute for roofing. Should spruce not be available, white birch bark will do as it will peel at any time in the year. The sheets are usually small and more apt to warp with the heat than spruce, but when well ballasted makes a passable roof.

Splice broken laces as in Fig 46. Split the end of each piece and put the end of each through the other.

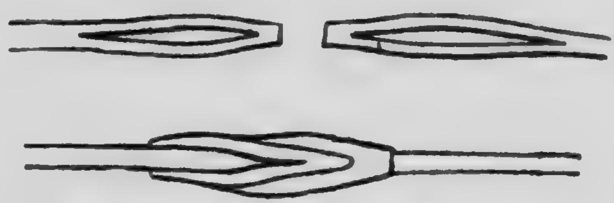


Fig 46. Simple belt splice.

Safety Hints—

Never twist the fuse around in a detonator while it is in contact with the composition. It is almost as dangerous as scratching it with a pin.

Never allow a man to make a charge or load a hole while smoking a pipe.

Never let him hold a lighted candle to a hole to see if the charge is down. If you have a man who does this let him turn the grindstone or feed hens or something else not above his ability.

Never pull a wire from an electric detonator or you may never have another chance to show how brave you are.

Never tap a detonator to knock the dirt out unless very lightly.

Never step on a detonator. You may need the foot again.

Never thaw dynamite before an open fire.

Never thaw dynamite in a pot on a stove. It may damage the pot.

To find out the quantity of water in a barrel.

Measure the ends and the middle inside in inches and then get the average width. Square this average

and multiply it by .785. Then multiply by the length inside and divide by 277¼. This will give the number of gallons in a barrel.

Multiplying the number of gallons by 10 will give the number of lbs.

[illegible] of Steel—

[illegible] steel	weighs	about	2 lbs 2 ounces	per foot.
[illegible]	"	"	1 lb, 11	"
[illegible]	"	"	1 " 4	"
1-[illegible]	"	"	12	"

[illegible] per cubic foot—

[illegible]	62½	lbs.
[illegible]	120 to 140	"
[illegible]	165 to 168	"
Lim[illegible]	168 to 170	"
Slate	165 to 174	"
Whi[illegible]	165	"
Quartz, with 15 per ct pyrites	184	"
Gold	1206	"
Hematite	267	"
Limonite	213	"
Zinc blend, (Black Jack)	235 to 250	"
Iron pyrites	286 to 300	"
Galena, (Lead ore)	425 to 470	"
Dry white pine, lightest wood	24	"
Iron	487	"
Mercury	848	"

Measurements for practical use—

Cubic ft. per ton, not broken.

Clay and earth, boulder clay	14 cu. ft.
Quartz and granite	13.5 "
Quartz with 15 per ct. pyrites	12.5 "
Limestone and syenite	13 "
Limonite	9 "
Hematite	7.5 "
Zinc blend (black jack)	8.5 "
Iron pyrites	7
Galena	4.7 "
Loose surface soil	20 to 22

Crushing load per square inch—

Working load ⅓ of crushing load.

Black spruce	5700 lbs	1900
White spruce	4500 "	1500

Melting points in degrees Fahrenheit.—

Tin	440
Lead	626
Zinc	680
Aluminum	1400
Copper	2100
Cast iron	2190

Steel	2520
Wrought iron	2900
Gold	2016
Silver	1873
Platinum	3630
Iridium	4890

Lasting qualities of wood--

Among the most lasting woods for mine timbers are white pine, oak and spruce. Cedar is of course the most lasting where obtainable but is wanting in strength.

Among the worst is popular, white birch, and beech in the order named, poplar being almost worthless.

Taking all qualities into consideration black spruce is probably the best and the most easily secured.

CHAPTER XXVI

Technical training for a prospector.

We have in that admirable institution, the Technical College at Halifax, an opportunity of turning out skilled workmen never before afforded the province. Workers in many branches of industry even to tailoring and millinery have in the night classes done themselves and their teachers credit.

Could prospectors also benefit by the instruction given at this school, gold mining would again become an important industry in Nova Scotia, for the prospector is the pioneer in this line. His importance to the industry has always been underestimated but it may be laid down as an axiom, "no prospectors, no mines." Once found, a good mine is able to help itself. The starting of new industries is very important to the progress of the country. Their neglect means the decline of prosperity and population, and in this neglect we Nova Scotians encourage emigration and general stagnation in business. The aiding of new industries pays the province better than the support of old ones. Therefore the establishing of a night class for prospectors would certainly benefit the province at large, could interest enough be aroused to collect a class.

The training necessary for a prospector, while it need only be rudimentary in some particulars, should be as complete in local Structural and Glacial Geology as it is possible to have it. While arithmetic is necessary, he needs algebra about as much as a horse needs to know the Latin name for oats.

He should be able to recognize any mineral that has been or may be found in the gold fields, but he does not need to get into a thorough study of the "ites" from Abriachanite" to Zonochlorite."

Next to Structural and Glacial Geology in importance comes a practical knowledge of manual labor, viz—how to sink pits, drive tunnels, timbering, panning, and how to get $2.00 worth of work out of a man for $1.50.

Structural Geology is probably the most important part of the prospectors studies and would include much of the matter given in chapters 3, 4, 7, 8, 9 and 10, but much more condensed. The instruction should begin with the assistance of maps, plans, sections and models. The subject may be treated in the following order.

1. General Geology. 2. Geology of the Nova Scotia

Gold Fields. 3. Local distribution of Rocks. 4. Anticlines and their Character. 5. Distribution of Anticlines. 6. Examples of Folds. 7. Thickness of Quartzites and Slates. 8. Cleavage and Bedding planes. 9. Gold deposits. 10. Bedded leads. 11. Fissure leads. 12. Gold bearing Drift. 13. Granite and its influence. 14. Age of Granite. 15. Faults and their influence. 16. Age and Classification of Faults.

Section 1 should deal with the world wide causes which led to present conditions in Nova Scotia, Original condition, cooling and crumpling of the earths crust and its effect on this province. 2 Local Structural Geology, being a study of the whin, slate, granite, gneiss, and schist composing the gold fields. This should be illustrated by a set of samples representing the different varieties of slate, whin, and other rocks. 3. Particular distribution of the rocks mentioned, with map. 4. Forms and nature of anticlines as vertical or overturned, elongated, oval, or circular. Synclines described, as main or parallel and cross synclines with figures. 5. Distribution of anticlines in sections, as in Chapter III. 6. Examples of folds, as in Chapter III. 7. Details of whin and slate series, thickness, color, and other peculiarities, with sections and mode of formation. 8. Cleavage and bedding planes with samples to show their differences. Show how mistakes are made. Peculiarities of each. Age and cause of cleavage. See Chapter III. 9. Likeness and differences between Nova Scotia and foreign gold deposits. Age and causes of deposition of gold in Nova Scotia. 10. Peculiarities of main leads and the occurence and cause of paystreaks or other form of gold deposits. 11. Fissure veins and their relation to faults. Cause of paystreaks in fissure veins. Age of same. 12. Gold in conglomerates of the Lower Carboniferous of Gays River Brookfield and other places in Colchester and Hants County. Gold in the sea sands of Ovens and lake bottoms of Tangier and elsewhere. See Chapters IV and XVIII. 13 and 14. The age and origin of granite is a much debated subject closely related to its influence on the gold fields. Its influence on the position of the anticlines and the formation of faults and gold bearing veins may be treated of. Metamorphosis of whin and slates. Later shrinkage of cooling granite, and the final fracturing or faulting of the granite and the filling of of these with ores are important items. 15 and 16. The faulting of the gold fields brings forward new problems of importance and more drawbacks for the prospector. This is a section on which much study may be profitably bestowed. A knowledge of local faults even of minor importance may mean much to the searcher after gold.

Too much cannot be known concerning the position, length, throw and course of the faults affecting the gold fields. These facts given in considerable detail in Chaper VIII, IX and X, are often of vital importance. Their age and classification is given considerable attention.

Problems in Structural Geology should be given to the students to work out and visits to the nearest mines or quarries undertaken as an aid to their studies.

Glacial Geology a very important branch, should include.

1. General or Continental Glacial Geology. Historical and Descriptive.

2. Provincial Glacial Geology. 3. Post Glacial modification. 4. The reading of the records in the clay. 5. Glacial markings. 6. Boulder trains. 7 Succession of beds with diagrams. 9. Accidents of nature. 8. Peculiarities and differences of Eastern and Western County drift. 10. Recurring Ice Ages. 11. Problems in Glacial Geology with plans and sections. 12. Visits to railway cuttings and other earthworks.

These points are treated at length in Chapters XI, XVII and XXIII. Section 1 should be considered as an introduction to Nova Scotian Glacial Geology in order to make the latter more easily understood. 2. This should be treated more fully and local details dwelt on. 3. The difficulties caused by the action of frost, rain, rivers, lakes, the sea, and even small brooks are well worth serious attention. The shifting of the boulder clay and its gold contents mean much to the prospector and the cause and result of these movements are of the greatest importance to him. 4. Signs that the prospector should be able to read. Work and money often saved by a correct interpretation of nature's books of clay. How to read them. 5. These markings are very important for they point out the way to the object of your search. Various sets of markings made by different causes. 6. Trains of gold bearing boulders. Their meaning is of great significance for they often mark the path to a rich vein. 7 Succession of beds showing unconformability, difference of age, and composition, by means of state of wear, rusted conditions, and other signs. Really a historical record. Illustrate with diagrams. 8. By accidents of nature is meant the results of landslides, freshets, the changed course of a brook, the removal of a bank, or the deflecting of a line of gold bearing drift. How to detect them. Illustrate with diagrams. 9. Show the difference between the much modified drift of the Western Counties and the less disturbed drift East of Halifax. Course of transportation, composition etc. 10. Show from good authorities and from local evidence the probability of several Ice Ages

in Nova Scotia. Show also their effect on the transportation and deposition of gold bearing drift, especially if transportation was on different courses. 11. Problems in Glacial Geology should be solved by the Students. Illustrate with plans and sections. 12. This subject could be made much plainer by visits to the nearest railway cuttings or other earthworks.

Mineralogy A general course in mineralogy would be a waste of time more needed for other branches. It should contain matter from or related to Chapter V and VI. Gold and its associated minerals should receive special attention. Then should come Tungsten, and the minerals of the granite tracts, manganese, silver bearing galena &c. Field tests for minerals are necessary, illustrated by samples in the Provincial Museum. Gravity and Hardness should also receive some attention as a further means of identification. Sets of specimens to illustrate these qualities are necessary It is needful also to know the conditions under which these minerals are found.

Blowpipe analysis Some practice in this in order to be able to make use of a simple outfit.

Qualitative analysis of the simplest form for those who wish to take it confined chiefly to the minerals of the gold fields.

The use of a compass can be taught with explanation of variations. The diurnal variation is too slight to affect the prospectors work and therefore need not be bothered with. A knowledge however of secular variation is necessary to the thorough understanding of the differences between old and new Government plans (See Chapter XIII.)

A knowledge of the use of the traverse tables may help to solve difficulties that cannot be otherwise overcome. Those in which distances are dealt with in detail are of more service to the prospector than those which give more place to the divisions of a degree. While the skill to calculate is useful, it is not necessary in the partially rudimentary course proposed. Therefore apart from a few simple geometrical rules everything of an advanced nature can be dispensed with, as the chief idea is to make a good prospector.

The Dip Needle or goniometer is a necessary article, and a knowledge of its use saves a lot of guess work.

Levelling A little knowledge of the level and its uses may be needful in case the prospector aspires to its possession. Drainage is a very important thing to him and the slope of the ground worked over, though it may be got at in a way with a carpenters level, should in some cases be measured with more exactness.

Map and Section making is a very necessary branch of prospecting. Though exactness is indispen-

sable, maps need not be elaborate, nor crowded with symbols that need much time to learn. It should show as simply as possible the necessary features of a district and give the information, actually needed and no more. While neatness of execution is necessary to distinctness it is not as important as usefulness. (See Chapter XIII.)

Panning is a very necessary part of prospecting where lines of gold bearing quartz is not well defined. Only the utmost care and much practice makes a good workman in this line. Class work would therefore consist chiefly in teaching a system of recording results which is very important in large tests. A test of good work in panning would consist of putting say 50 colors of gold in 5 or 6 lbs of sand and allow the student to pan them noting how many are recovered. See Chapter XIV.)

System in prospecting. Compare the old and new methods, as in Chapter XVII,—drift tracing as opposed to bottoming. Economy in work, illustrated by diagrams. Recording work and costs. The dominant idea in this branch is "Never prospect in ground containing no gold except under expert advice." Also this "Never sink your pits or trenches below the gold bearing layer unless you have good reason to think there is another like layer or lead below or the surface is shallow.

Timbering, as illustrated in Chapter XIX. A system of removable lagging. The economy of the system. The strength of timber. Comparison of the the woods common in Eastern Canada. Crushing load. Working load. Lasting qualities dry and green. Weight.

Core Drill work. Its advantages and disadvantages. As an aid to the prospector. See chapter XXI. Comparison of the Calyx and diamond drill, in speed, costs and usefulness of the work done. Care of the drill and its equipment and knowledge of its construcion. How to start a hole. How to run a drill. How to record the results.

Steel working and tempering. (See Chapter XXV.) A forge is indispensable in this branch. Pick sharpening. Form of point and temper for earth work. Drills. The different forms ot point for hard, soft, and tough rock with the temper for each. Heating and working. Welding. To renew burnt steel. Melting point of metals. Weight of steel and iron bars per foot of different sizes.

Care of Explosives. Instructions on those in common use in Eastern Canada. Composition. Care required in thawing and handling. Fuses, ordinary. Safety fuses. Electric fuses. Use and care of battery.

Detonators. Composition and care of same. Blasting General safety hints. Transportation and storing of explosives. Laws regarding explosives,

Measurement of earthwork, earth, rock water, and ores deserve attention. Weight of ores, rocks, metals, and water per cubic ft per ton of water, ores, rock, earth &c in the solid or broken, with impurities, which is their usual state. Measurement of ore water &c, barrels.

Arithmetic, Such branches as are necessary.

Bibliography. A list of books for reference noted more for conciseness and simple language in necessary branches than as exhaustive treatises which are too often recommended.

This chapter is offered only as a suggestion that appears to me possible to carry out and which certainly is urgently needed. That a course of instruction on these lines if carried through would be beneficial to the province, no thinking man can deny. A perusal of Chapter XXII, "Some hidden Bonanzas," will convince the reader that there are yet in Nova Scotia nearly 100 undiscovered leads of much value. Some of these, though searched for at intervals for nearly 50 years past, have defied the efforts of the old style prospector. And yet in justice to his dogged perseverence without funds, he would have done better had he been properly supported by some of those who have put Nova Scotian money into foreign mining stocks by the hundreds of thousands of dollars. It would no doubt pay better to pay for the education of some of our intelligent young men on the lines suggested above and set them to work in the search for some of our own bonanzas, than to drain the province of our surplus cash in some outside get-rich-quick scheme.

The Outlook for Gold Mining in Nova Scotia.

Before closing I would like to say a few words on the prospects for a revival of gold mining in Nova Scotia.

Nature has given this province a splendid position in the commercial world, a position of which its people have not taken advantage. Halifax is nearer Europe than any other city on the American Continent. In August, 1914, the Mauratania left Halifax and arrived at Liverpool, G. B., in four days and 6 hours. It is nearer the worlds great markets than any other part of Canada. And yet in spite of her great resources her people are few because of their lack of confidence in their own country. Emigration is rife because of lack of opportunity for the workingman. And this lack of opportunity is because of lack of investment by our moneyed men. Money is tied up in the Banks or invested in foreign stocks, and though shipbuilding and steel works are talked of nothing is done. There was a time in the days of wooden ships that Nova Scotia owned more tons of shipping per head of population than any country in the world. This shows what this province is capable of but now enterprise seems dead in spite of the hoarded dollars.

Nova Scotias coal and iron resources are well known but not worked to the extent they could be. She has large unworked deposits of gypsum, barite, iron, infusorial earth, umber, plumbago, copper, gold, antimony, manganese, tungsten, silver bearing galena, and late discoveries of tin, and other metals mostly unworked. Her forests contain large quantities of valuable timber including pine, spruce, oak, ash, birch and other woods. The fertile soil of the northern counties grow the very largest crops of hay and vegetables, while the fruit growing sections surprise the world with the perfection and flavor of their apples. Nova Scotia exported of this favored fruit in 1911, 1,500,000 barrels. Its fisheries are among the most famous in the world, and furnish work not only for its own fishermen but for thousands from the United States. Its mineral display, especially its gold, has been the admiration of visitors at the various exhibitions.

Among the things that Nova Scotia can claim credit for are the following:—

1st—The largest coal mining shaft in the world.

2nd—The record for one days hoisting from one shaft-viz-4500 tons.

3rd—The largest coal seam in the world.

4th—More coal mined than all the rest of the Dominion.

5th—More iron smelted than all the rest of the Dominion.

6th—First prize for its gold exhibit at the Jameston Exposition.

7th—A larger export of apples in 1911 than any Canadian Province.

8th—A larger export of lobsters than any country in the world.

9th—A larger export of gypsum than any country in the world.

10th—And formerly a greater tonnage of shipping per head of population than any country in the world.

These few items are the record of a country whose money is sent abroad, whose resources lie mostly undeveloped. whose sons emigrate to other lands, and whose business enterprise has succumbed to the dry rot of fear of disaster or fear of combines. Who can say which? This record is but a fraction of what might be done were we as devoted to the interests of Nova Scotia as we are to those of the West.

There are of course drawbacks. Nova Scotia cannot hope to equal in mining successes the large and rich mining centres of the Rand, Cobalt the Yukon, Colorado, and other places in the race for the patronage of the capitalists. But for the small investors we offer as good a field as it is possible to find.

For a generation our papers and promoters have been talking of big mines and low grade ores. Gallons of ink have been wasted on the subject without better results then several disasters and an intense prejudice among foreign investors. And during all this time millions of dollars lie buried beneath the drift hills of our golden districts in small but often exceedingly rich veins. These require but little capital to uncover and develop as $10.000 will put almost any one of them on a dividend paying basis. And while the costs are small the percentage of profit has been far greater than could ever be hoped for from any low grade large mine in Nova Scotia. Fortunes were made from the rich veins of this province before the low grade craze was started.

As an example of the productiveness of Nova Scotia gold ores I will give a table from the sworn returns on file at Mines Office; dated July 16, 1906; and signed by the Deputy Commissioner of Mines at Halifax, N. S.

District	Name of Owner	Date of Crushing	Tons Crushed	Yield of Gold Ozs.	Dwt.
Oldham	Oldham Gold Mg Co	April, 1889	144	804	14
"	" "	May, 1889	132	503	7
Stormont	Gallihar Gold Mining & Milling Co.	Nov., 1883	50½	189	19
"		Dec , 1883	53	189	13
"	" "	Jan'y, 1884	64	208	3
Whiteburn .	McGuire & Company	Jan'y, 1888	35	139	1
"	" "	Feb., 1888	34	142	8
"	" "	Mar., 1888	33	148	13
Renfrew.	Pictou Development & Mining Co	Aug., 1902	75	350	0
"		Sept., 1902	60	400	0
Mt Uniacke	Hopgood & Company	Mar., 1902	116	539	0
"	" "	April, 1902	51	241	0
"	" "	May, 1902	86	301	11
Montague ...	New Albion Gold Mining Co.	Sept , 1885	336¼	1869	0
" ...		Sept., 1889	30	173	8
Malaga	Parker-Douglas Co.	Oct., 1891	72	239	14
Caribou......	Elk Mining Co.	April, 1887	80	341	0
"	" "	May, 1887	45	249	0
"	" "	Aug., 1887	21½	79	2
Gold River..	North Star Mine	May, 1884	21 1-5	97	18
" .	"	Nov., 1884	27	75	0
" ..	"	Dec , 1884	8½	33	15
" ..	"	April 1885	½	15	23
" ..	"	"	16¼	61	14
Ctl. Rawdon	Northup Mine	July, 1898	30	141	18
"	"	Sept., 1898	80	364	0
"	"	June, 1899	100	394	0
			1810½	6782	13

A summary of the above shows a yield of 3 ounces 15 pennyweights per ton and shows well the possibilities of Nova Scotia gold mines almost without capital. These are only a few of the rich yields of the past, and that the leads yet uncovered will yield equally well there is little doubt. While these rich veins exist which no one who has mined in Nova Scotia will doubt, why should we waste our lives in vain struggles for an amount of capital we cannot get and know we cannot get.

Therefore let us cease to waste ink and breath in vain attempts to boom low grade ores and unite our efforts on some of our still hidden bonanzas. If we cannot find a large profitable mine let us unite the small rich ones into one large enterprise as F. W. Woolworth did his 5 and 10 cents stores. We have the money and surely we can find the brains, skill, and enterprise. I dealt with some detail on this subject of co-operation in gold mining in a paper read before the 1911 meeting of the Nova Scotia Mining Society and would welcome any criticism that would help to make the subject more clear.

It is often most surprising to a Nova Scotian especially in the United States to notice the intense and unreasoning prejudice against Nova Scotian mines,

and this in spite of the fact that the Dominion Coal Company has paid a larger sum in dividends at least up to 1908 than any mining company in Canada. This feeling is most intense against our gold mines and except among the better informed it is a permanent bar to business. The chief cause of this prejudice are the operations of unscrupulous promoters who cajole their friends into stock schemes in which by various methods known in high finance the money invested gets no further than the promoters pockets. The blame as usual is put on the Nova Scotia mines and miners.

A Boston real estate man firmly believes that a Cambridge friend of his lost 1½ millions of dollars in a Nova Scotia mine. A liberal estimate of all work and plant at this mine both above and below ground at prevailing prices shows that it could not cost $200,000 even if no gold were ever obtained. Therefore it is no wonder that the most ridiculous yarns are believed when a man of fair intelligence will give vent to such fairy tales.

Many of these investors, who buy sheets of gilded and decorated certificate from their American friends would consider it a sign of recklessness if they should put up a small mill for a half interest to help out some struggling miner who owns a small but rich vein. They dearly love to be in with the successful man forgetting that as a rule he is successtul because of the money he gets from his friends.

The bias in favor ot low grade ore, big mines, big mills, big capitalization, and high salaried foreign managers who are ignorant of local conditions in Nova Scotia should die out in time and give our small rich veins a chance as in the days of yore. As more than one authority has said, this is the land of the small capitalist. Nearly all our high grade mines have paid their cost, some of them several times over, when the owners knew when to stop, for the life of no mine is infinite. This should show investors which way the road to success lies.

To the small investor I would say, help the man who you see is helping himself, even though he goes under while doing so. There is no better guarantee of good faith than a struggle against overpowering odds. And if the man of dollars is built on the selfish lines necessary to make him a brilliant financier, let him help the man who is down, tor with him he can drive a better bargain than with the manwho is so elated by success that he will neither bow to force nor listen to reason or flattery.

Finally I would say that if nearly a lifetime of experience in the gold mines of Nova Scotia is of benefit to prospectors or intending investors, I am at their service.

Appendix I.

Approximate Prices of Minerals, Ores, and Metals.

Substance	Quantity	Price 1914	1906	Remarks
Asbestos	Ton	$125 to $150	$175.00 200.00	....
Arsenic oxide...	"	$90.00	60.00 to 100.00	....
Barite	"	$16.50 17.00	$700	Washed
Carnotite........	lb.	$5.00	......	2 p.c. Uranium oxide
Chalk	Ton	....	$3.00	....
Chrome ore. ...	"	$14 to $16	25.00	50 p.c. long ton
Corundum	lb.	10-17 cts.	5 to 10c	granular
Coal..	Ton	$2.95	$2.00	....
Cryolite	lb.	5¼ cts.	6½	....
Emery...	"	1¼-2 cts	....	flour
Feldspar	Ton	....	$9.00	....
Fluorspar	"	$8.00-9.00	10.00 to 15 00	....
Garnet	"	$25.00-25.00	25.00 to 35.00	....
Graphite	lb.	4c–9c	(150 00) ton	lump
Gypsum	Ton	$1.40 to 2.50	$2.00	ground
Infusorial earth	lb.	¼-2¼ cts.	....	....
Iron ore...	Ton	$2.85 - 3.00	4 00	non Bessemer
Lime....	barrel	$1.10	80c	....
Magnesite	Ton	$30.00-35.00	....	Calcined & powdered
Mica, ...	lb.	5c. to $2.75	12c to $200	
Molybdenite ...	Ton	$12 per unit for 90%		....
Moulding sand	"	....	....	....
Pyrites...	"	....	12c per unit	....
Quartz crystal.	"	$5.00 f.o.b		....
Slate........	100 sq. ft.	....	2 00 to 10 00	....
Scheelite..	Ton	$550.	$300	75% $CaWO_4$
Soapstone...	"	$12.00	11.00	....
Talc	"	$12 to 25	20.00	For No. 1
Sulphur	100 lbs.	$2.25	....	....
METALS				
Aluminum	lb.	17¼ to 20c	40c	No. 1 ingots
Antimony	"	7¼ to 8c	9c	....
Bismuth	"	$1.95 2.15	42.10	....
Cobalt	"	....	2.50	....
Copper Ingots..	"	14 to 15 cts	....	....

Substance	Quantity	Price 1914	1906	Remarks
Gold (Fine)	Troy oz.	$20.67	$20.67	
Iron (pig)	Ton	$13 50-16.00		
Lead	lb.	4¼-5cts		
Manganese	"	2c	3c	Dioxide.
Mercury	"	51c	45c	
Molybdenum	"	$2.25	1.75	
Nickel	"	40 to 45c	40c	
Platinum	Troy oz.	$45.00-48.00	$25.00	
Potassium	lb.	7½-8½ cts.	6c	Bicarbonate
Radium (Bromide)	milligramme	$35.00		
Silver	Troy oz.	56c	60c	
Strontium	lb.	40c	50c	worth $200 per lb. in 1895
Thorium (nitrate	"	40c		Oxide
Tin	"	31c to 35c		50 p.c. pure
Tungsten	per unit	$5 40		Hydrated
Uranium oxide	lb.	$4.80		
Vanadium	lb.	4.50		
Zinc	lb.	7-8		$55 for 60 p.c. ore

The above prices are merely added to afford an approximate or rough idea to the prospector of what his material may be worth, the tendency is always towards lower prices, as for instance strontium, excepting in the rarer minerals or elements such as molybdenum, vanadium, platinum, etc. Prices also vary much, depending on the percentage or richness of the ore and its freedom from admixture with undesirable elements.

APPENDIX II.

List of Useful Books.

The books mentioned below or any others may be obtained through the Industrial Publishing Co., Limited, 37 Sackville Street, Halifax, N. S.

Title	Author	Price
Prospecting for Minerals.	Cox	$1 50
Geology for Beginners	Watts	75
First Book of Geology	Shaler	70
Geological Story	Dana	1 15
The Earth and its Story	Heilprin	1 00
Elementary Geology	Tarr	1 40
Ancient Life History of the Earth	Nicholson	2 00
Handbook of the Rocks	Kemp	1 50
Elements of Geology	LeConte	1 20
Geology of Nova Scotia (Last Edition)	Dawson	4 00
Minerals and How to Study Them	Dana	1 50
Mineral Deposits	Lindgreen	5 00
Common Minerals and Rocks	Crosby	60
Mineralogy of the Rarer Metals	Cohen & Wooton	1 75
Tables for the Determination of Common Minerals...	Crosby	1 75
Minerals and How they Occur	Miller	1 00
Qualitative Analysis (a Short Course)..	Appleton	75
Assaying	C. H. Aaron	2 50
Cyanide Process	Park	2 50
Traverse Tables	Louis & Caunt	2 00
Economic Mining	Lock	3 00
Mine Surveying	Gough	2 50
Reports of Dominion Geological Survey	Faribault	....

APPENDIX III.

Glossary of Words Not in Common Use.

Streak is the color of the dust left when a mineral is scratched on a harder substance.

Lustre is the appearance of the surface of a mineral when broken.

Metallic lustre is a partly shining surface.

Columnar, coarsely fibrous or in long crystals.

Fibrous, like fibres or hair.

Submetallic, approaching the appearance of ordinary rock.

Magnetic, attracted by magnet when powdered or attracting the compass needle.

Stalactitic, hanging down like icicles.

Maleable, Easily beaten out or bent.

Foliated, in scales or layers, finely laminated.

Radiated, Star like with fibrous crystals starting from centre.

Cleavage, liability to split in a certain direction.

Fracture, condition of surface after breaking.

Mamillary, full of small rounded elevations.

Resinous, with a surface resembling that of resin.

Compact, dense or fine grained.

Curved, Used here only as a substitute for conchoidal

Lamellar, in plate or layers.

Oxide, a combination of a mineral with oxygen, as Fe. O. =, iron rust.

Elements as a name in Mineralogy includes all known substances.

Sulphid, a combination of a mineral with sulphur, as Fe S, iron sulphid.

Carbonate, a combination of a mineral with carbonic acid, as Fe Co2

Reniform, Kidney shaped.

Erosion. The wearing down of the earths surface, by ice, water, and other agencies.

Stria, furrows in the rocks caused by the passage of drift during the Glacial Age.

Pitch, the inclination of an anticline lengthwise.

Dip, inclination of rock layers or leads.

Strike, course of whin and slate belts and leads.

Quartzite, whin.

Arenaceous, sandy usually applied to sandy slates.

Argillaceous, clayey usually applied to clay slates.

Anticline, a fold or crumple in stratified rocks.

Syncline, a hollow or downward bend of strata between two anticlines.
Strata, layers of rock.
Stratified, in layers or beds, applied to sedimentary rocks.
Sedimentary, laid down by water.
Laminated, in thin seams.
Metamorphic, melted or baked by heat.
Dyke, a crack filled by rock when in a molten state.
Micaceous, full of mica or scaly, like mica, as micaceous iron ore.
Talcose, full of talc.
Gneiss, rock containing the constituents of granite but in layers.
Schist, a rock in thin layers, usually containing much mica.
Batholith, a deep seated expansion of the stratified rocks filled with eruptive rock.
Zone, a rich gold bearing section across a beltof leads.
Symbol, letters used as a substitute for longer words.
Epoch, a period of time, as a Glacial epoch.
Phase an aspect, a part of an operation.